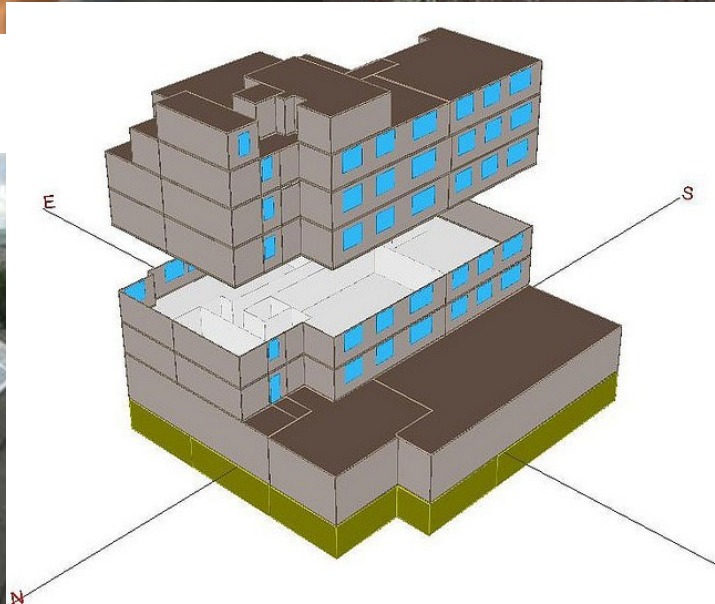
Energy Modeling 401
Load Calculations
Trane Trace 700

Regional Energy, Sustainable and LCCA Center of Expertise (RECx)
Pacific Ocean Division
December 2012



US Army Corps of Engineers
BUILDING STRONG®

TRAINING OBJECTIVE

- Audience – HVAC engineers
- Difference between energy model and load calc.
- Trane Trace 700 input and output screens

AGENDA

- Terminology, Definitions
- Requirements for energy modeling
- Process
- Energy model vice Load calculation
- Trane Trace 700 Inputs
- Trane Trace 700 Outputs
- Questions/Comments

Terminology

- "R-value" (or "U-factor") – thermal resistance

- SHGC or solar heat gain – heat from the sun, typically thru windows.

- Schedule – when something is on or off, also used when the building is occupied. Usually used as a percentage of fully "on" or occupied.

- Building mass – "thermal inertia" or the ability (rate) of a building to absorb or retain heat. The higher the building mass, the more heat energy is retained in the building over time.

- Plug or Process loads – typically loads that are plugged in. An example would be a desk fan or a desk light.

- HVAC – Heating, Ventilating and Air Conditioning

Terminology (con't)

- ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

- ASHRAE 90.1 or ASHRAE Standard 90.1-(referenced by year) – Energy Standard for Building Except Low-Rise Residential Buildings

- ASHRAE 189.1 or ASHRAE Standard 189.1-(referenced by year) – Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

- Economizer – typically refers to scheduling an HVAC system to blow air without the heaters and chillers being on.

Terminology (con't)

- Energy Model (ASHRAE 90.1 requirements)

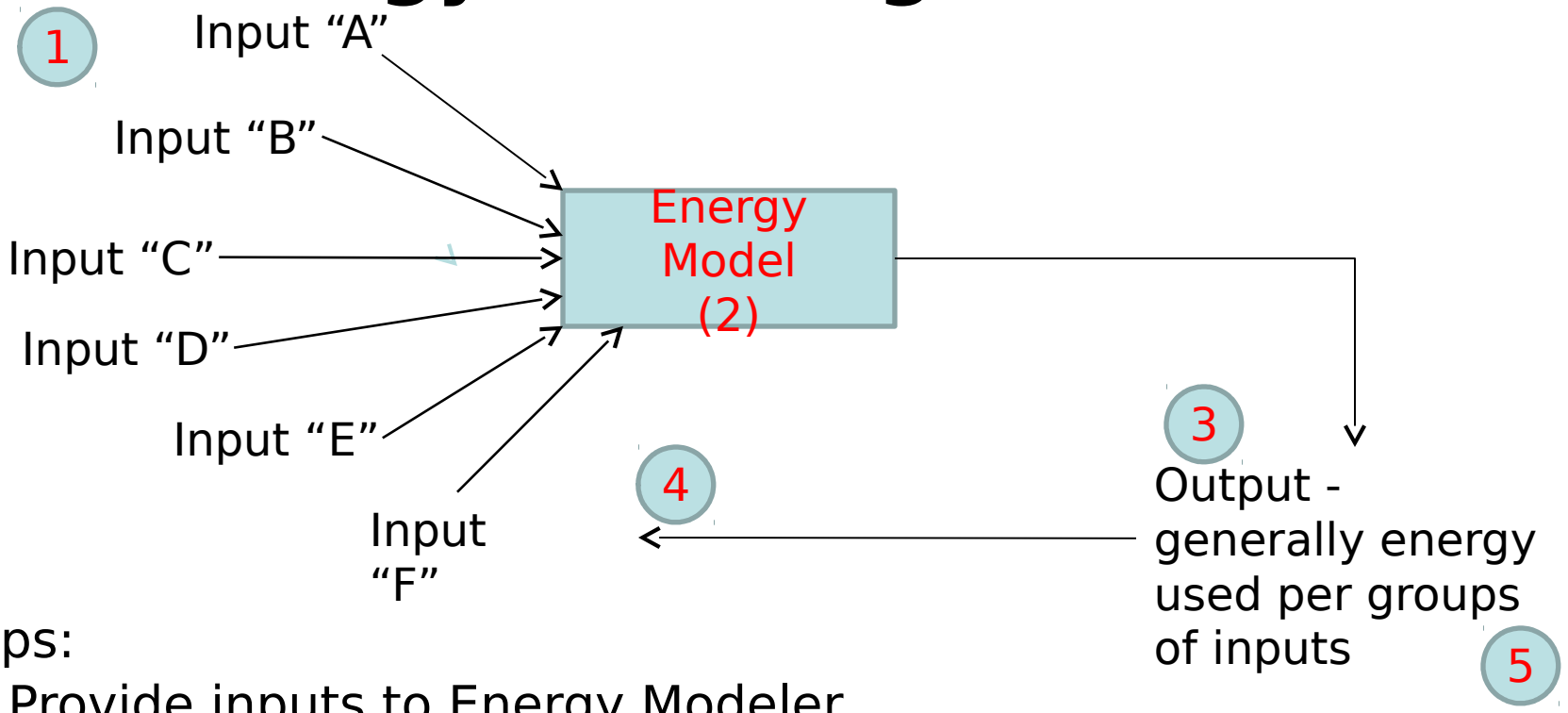
"G2.2.1 The simulation program shall be approved by the rating authority and shall, at minimum, have the ability to explicitly model all of the following:

a. 8760 hours per year
b. Hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation, defined separately for each of the week and holidays
c. Thermal mass effects
d. Ten or more thermal zones
e. Part-load performance curves for mechanical equipment
f. Capacity and efficiency correction curves for mechanical heating and cooling equipment
g. Air-size economizers with integrated control
h. Baseline building design characteristics specified in Section G3"

Energy Modeling Requirement

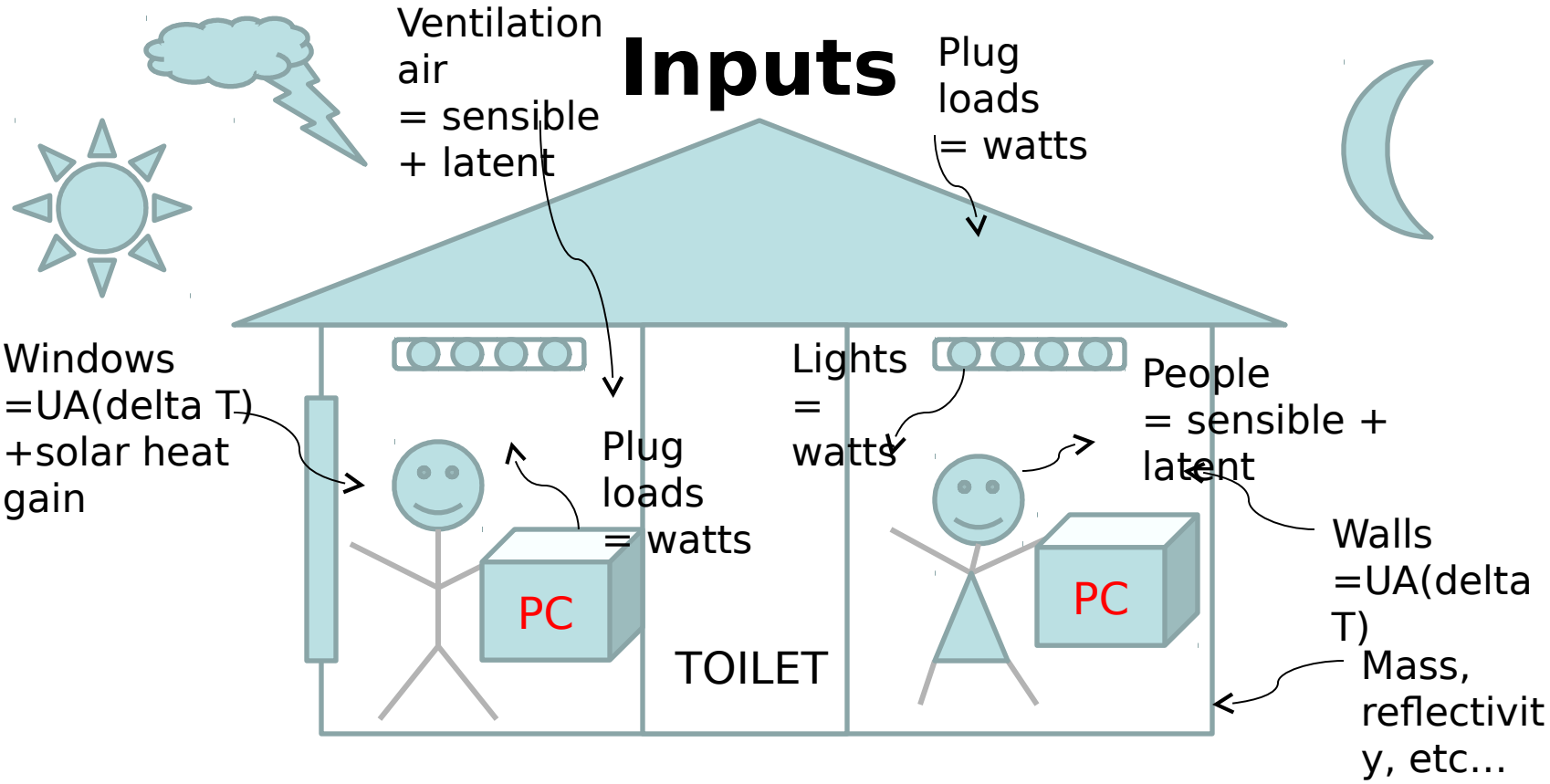
- "Gotta do it"
- (draft) UFC 1-200-02
- EISA 2007
- EPACT 2005
- DoD Sustainable Buildings Policy. October 25, 2010
- Dept. Army Memorandum. Subject: Sustainable Design and Development Policy Update (Environmental and Energy Performance). October 27, 2010
- ECB's (i.e. ECB No. 2011-1)
- Others…….

Energy Modeling Process



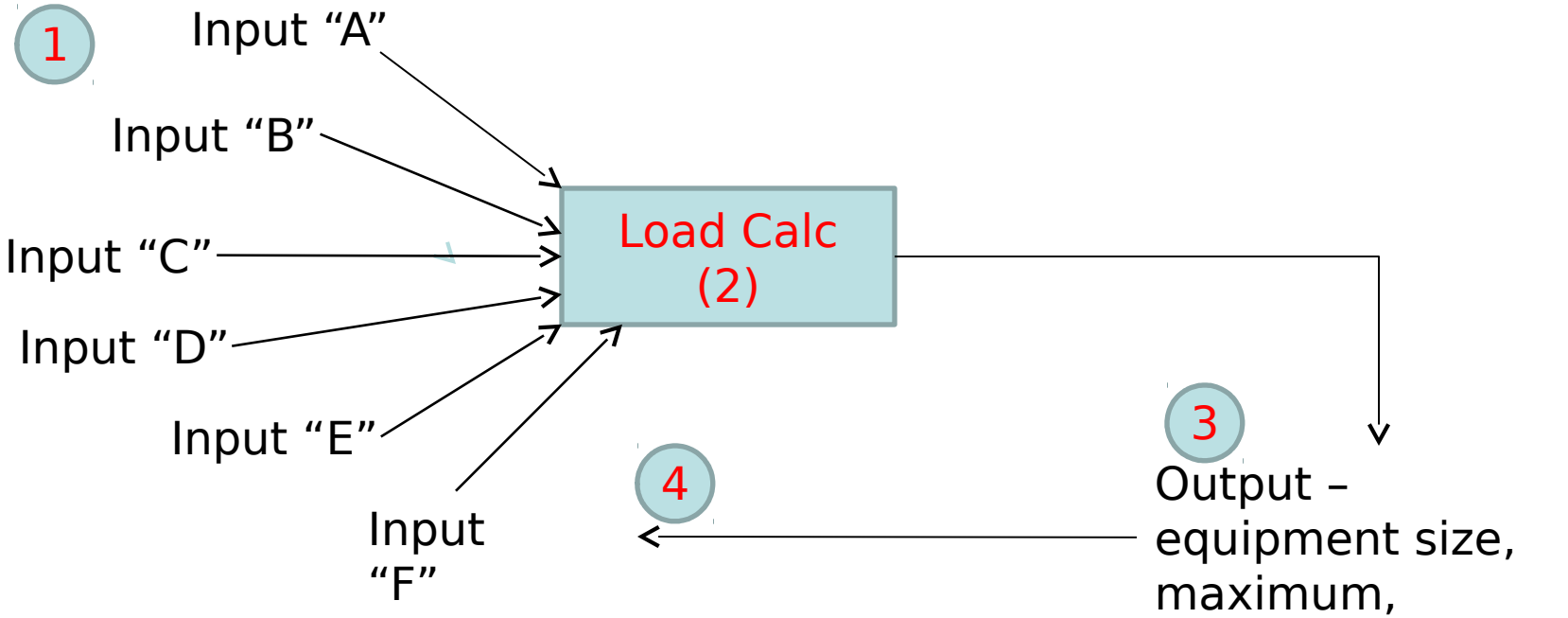
Steps:

1. Provide inputs to Energy Modeler
2. Energy Modeler to calculate baseline and proposed building
3. Analyze outputs to determine “biggest bang for the buck”
4. Modify inputs and provide to Energy Modeler
5. Repeat, repeat, repeat until desired outcome is met – design is an iterative process….



___Site Plan with North arrow, project location, local weather data
___Conditioned area, Semi-Conditioned area, Non-conditioned area
___Number of floors. Floor-to-floor height
___Utility rates (Electric, Gas, etc…)
___Space (building) usage, Lighting and schedules
___Building envelope and interior partitions
___Building electrical and process loads and schedules
___Mechanical and plumbing details and schedules

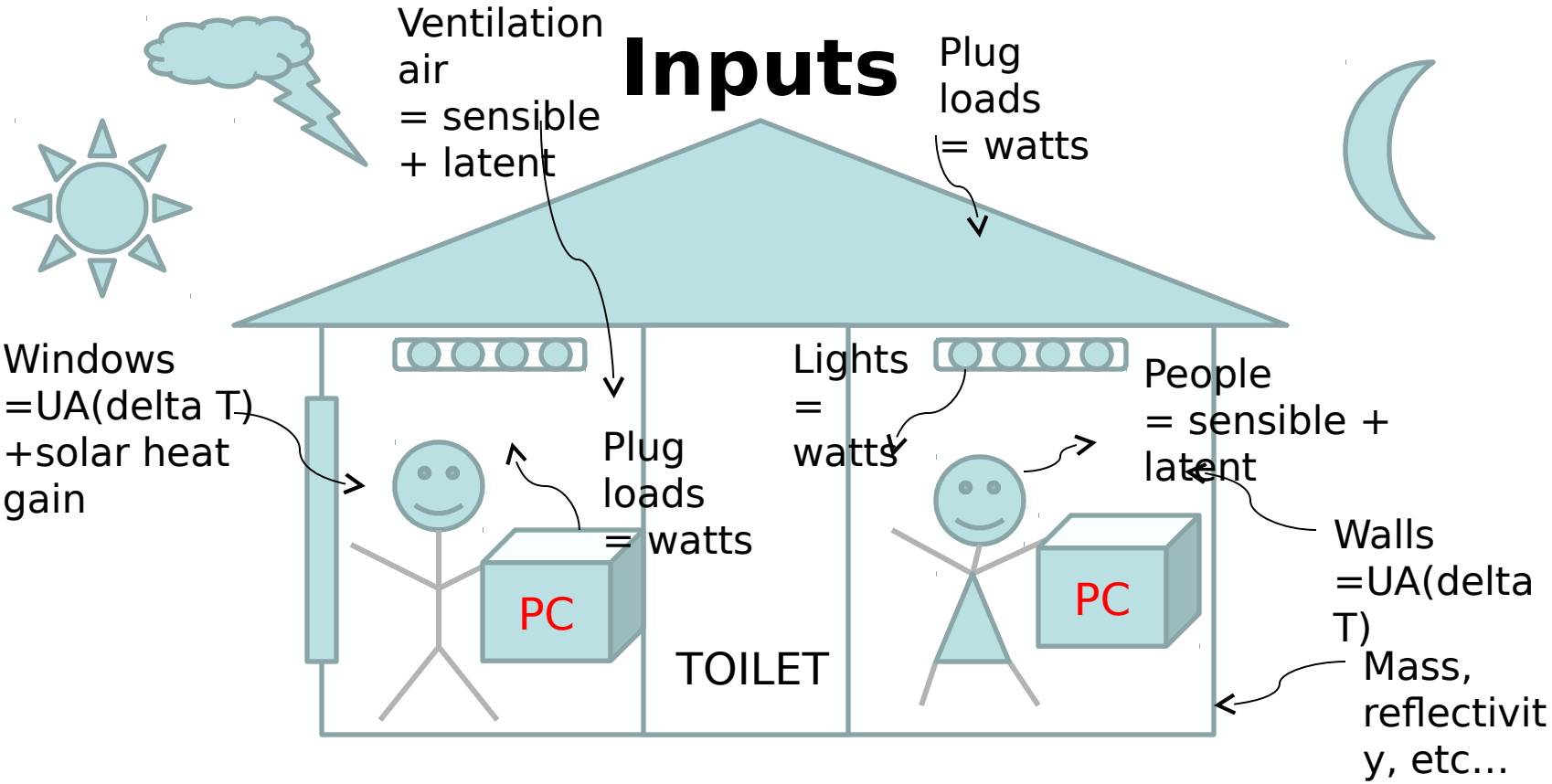
Load Calculation Process



Steps:

1. Provide inputs to load calculation
2. HVAC engineer to initially size system
3. Analyze outputs to determine concept/final equipment/system
4. Modify inputs based on system(s) selected and re-run calc
5. Repeat, repeat, repeat until equipment/system is proven – design is an iterative process….

Inputs



___Site Plan with North arrow, project location, local weather data
___Conditioned area, Semi-Conditioned area, Non-conditioned area
___Number of floors. Floor-to-floor height
___~~Utility rates (Electric, Gas, etc…)~~
___Space (building) usage, ~~Lighting and schedules~~
___Building envelope and interior partitions
___Building electrical and process ~~loads and schedules~~
___~~Mechanical and plumbing details and schedules~~

Energy Model vice
Load Calculation

- Energy Model (objective) =

  Predicted annual energy usage

- Load Calculation (objective) =

  Equipment sizing

  Max. heating load Max. cooling load

  Min. heating load Min. cooling load

Welcome to TRACE 700!

Technical Support

This Help file, in conjunction with the Getting Started Manual and User's Manual provided with this program, should answer most of your questions about TRACE™ 700.

For advanced assistance with this software or with modeling and analyzing HVAC loads, contact the C.D.S.™ Support Center.

To reach us:

phone:	608-787-3926	**Hours**
fax:	608-787-3005	Monday-Thursday
e-mail:	cdshelp@trane.com	8:00 a.m. - 5:30 p.m. (Central)
mail:	Trane	Friday
	Attn: C.D.S. Group	8:00 a.m. - 5:00 p.m. (Central)
	3600 Pammel Creek Road	
	La Crosse, WI 54601-7599	

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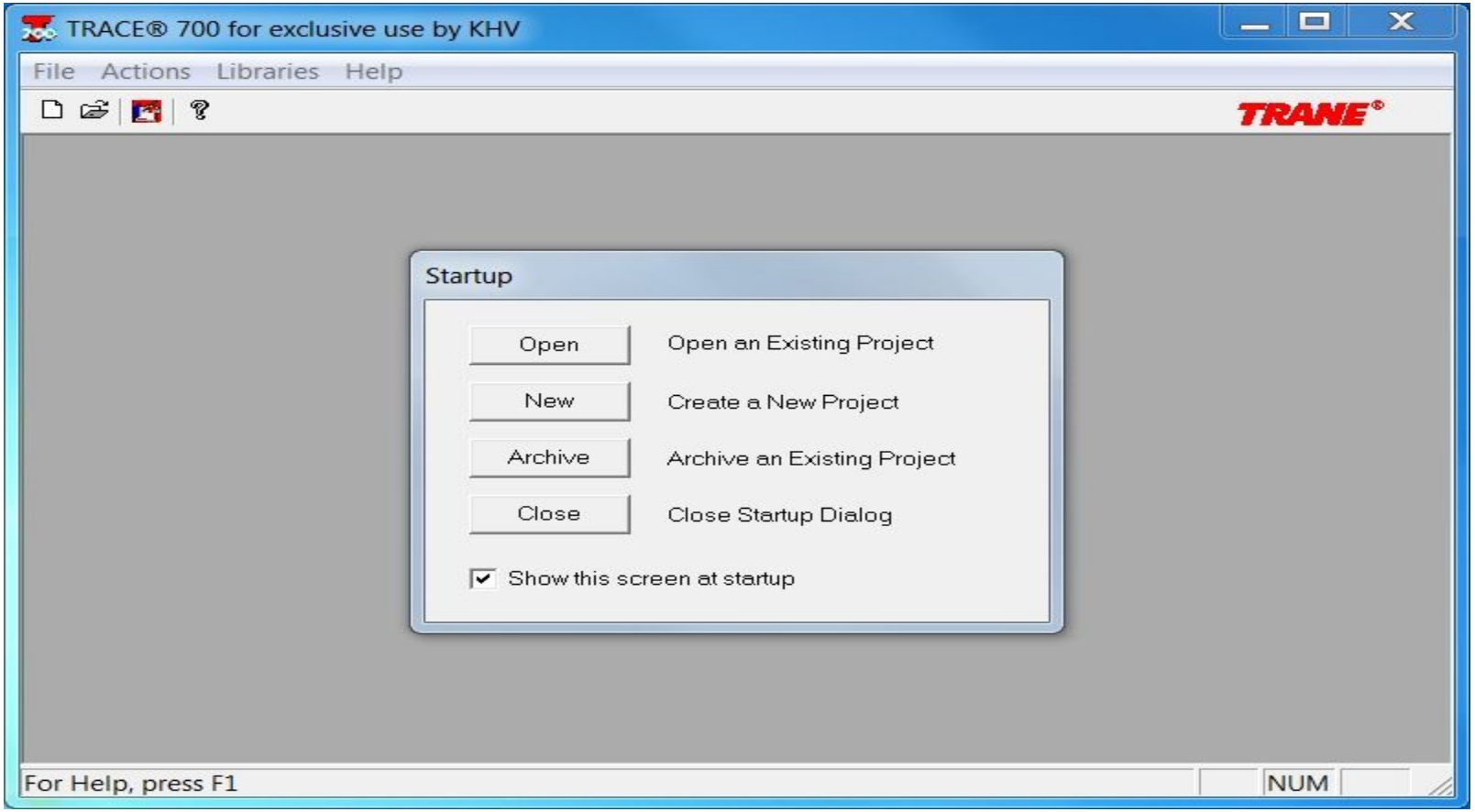
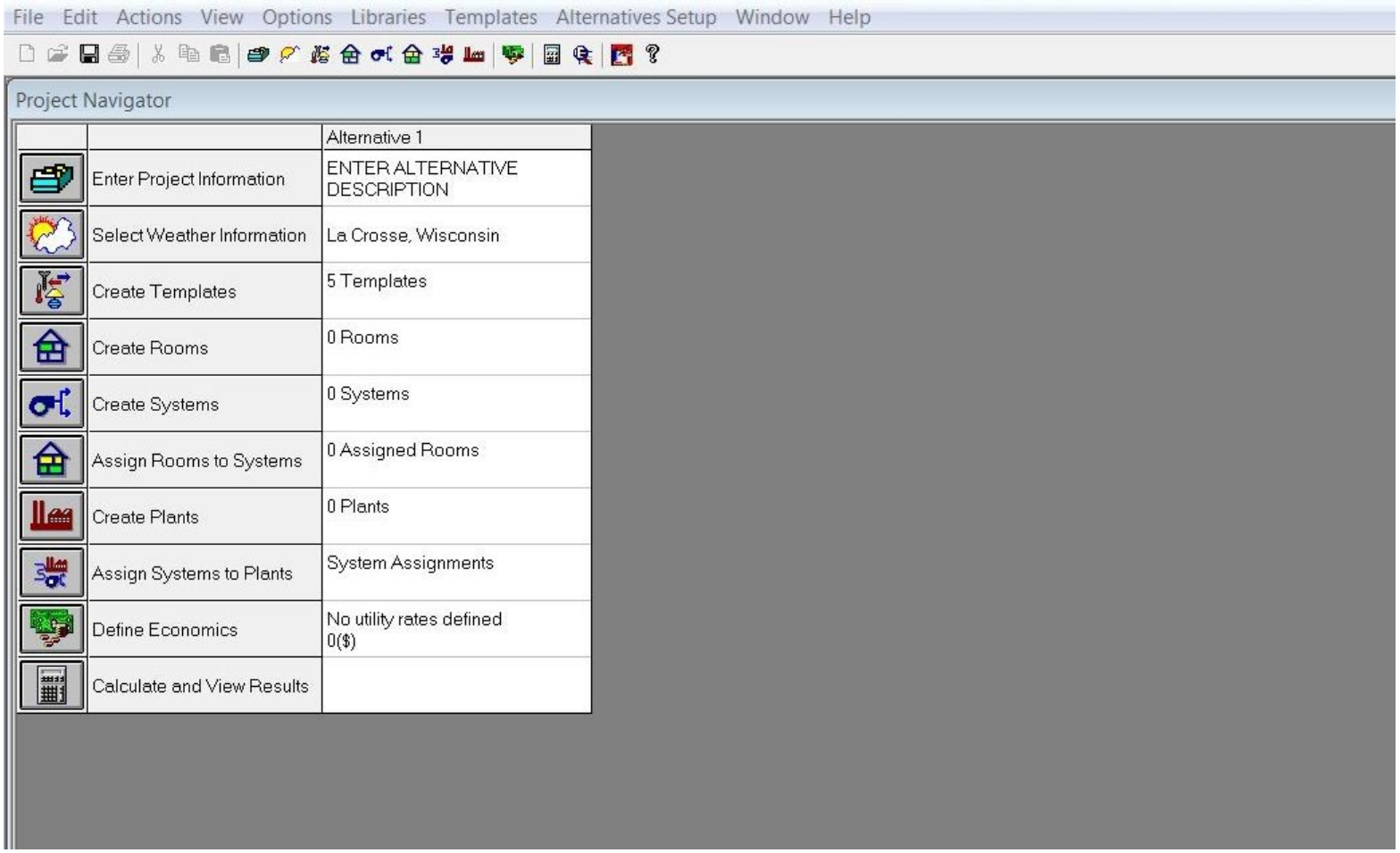
We are committed to continuous product improvement. Please send comments to cdshelp@trane.com and be sure to include the name and version of the program.

BUILDING STRONG®

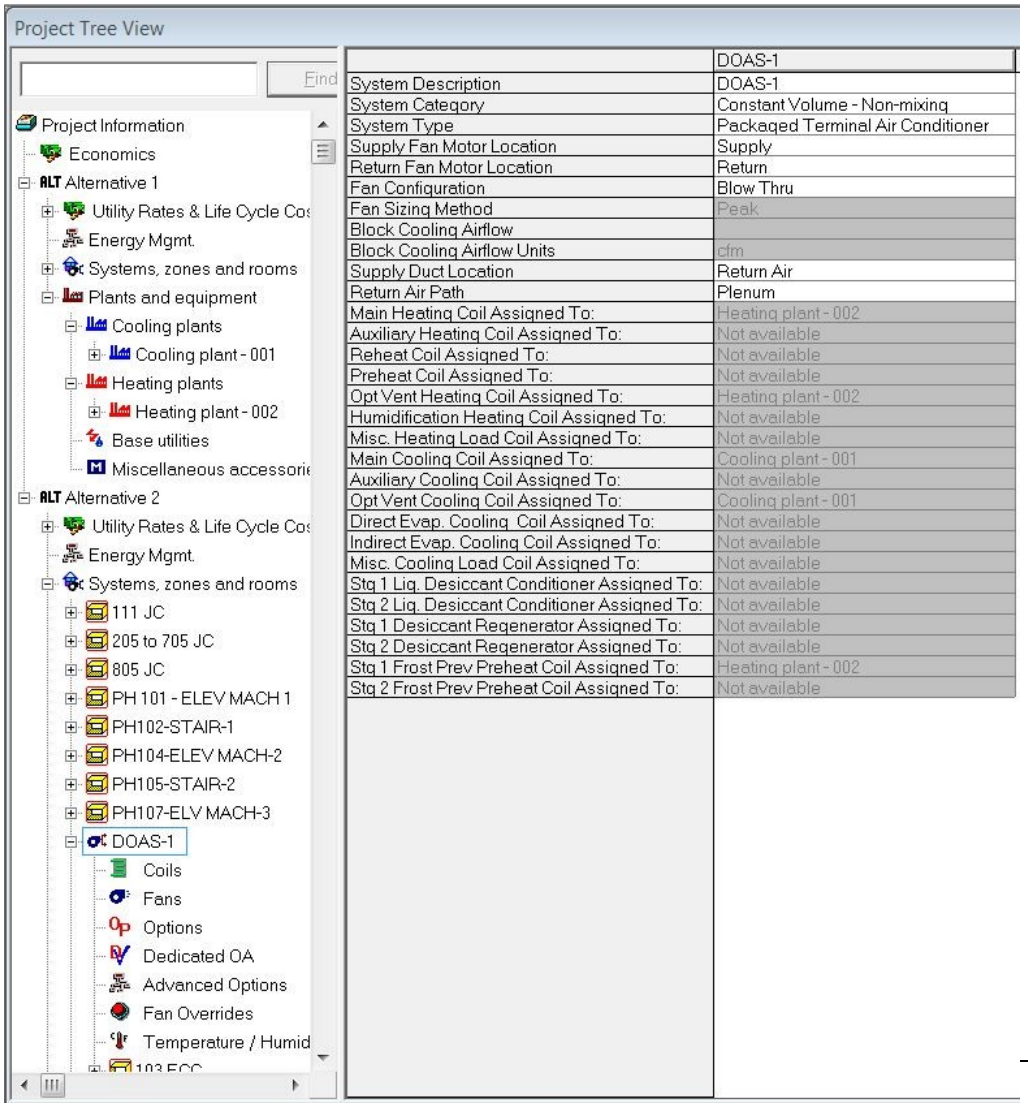
Creating A New Project



Project Navigator View



Project Tree View



	DOAS-1
System Description	DOAS-1
System Category	Constant Volume - Non-mixing
System Type	Packaged Terminal Air Conditioner
Supply Fan Motor Location	Supply
Return Fan Motor Location	Return
Fan Configuration	Blow Thru
Fan Sizing Method	Peak
Block Cooling Airflow	
Block Cooling Airflow Units	cfm
Supply Duct Location	Return Air
Return Air Path	Plenum
Main Heating Coil Assigned To:	Heating plant - 002
Auxiliary Heating Coil Assigned To:	Not available
Reheat Coil Assigned To:	Not available
Preheat Coil Assigned To:	Not available
Opt Vent Heating Coil Assigned To:	Heating plant - 002
Humidification Heating Coil Assigned To:	Not available
Misc. Heating Load Coil Assigned To:	Not available
Main Cooling Coil Assigned To:	Cooling plant - 001
Auxiliary Cooling Coil Assigned To:	Not available
Opt Vent Cooling Coil Assigned To:	Cooling plant - 001
Direct Evap. Cooling Coil Assigned To:	Not available
Indirect Evap. Cooling Coil Assigned To:	Not available
Misc. Cooling Load Coil Assigned To:	Not available
Stg 1 Liq. Desiccant Conditioner Assigned To:	Not available
Stg 2 Liq. Desiccant Conditioner Assigned To:	Not available
Stg 1 Desiccant Regenerator Assigned To:	Not available
Stg 2 Desiccant Regenerator Assigned To:	Not available
Stg 1 Frost Prev Preheat Coil Assigned To:	Heating plant - 002
Stg 2 Frost Prev Preheat Coil Assigned To:	Not available

Component Tree View

File Edit Actions View Options Libraries Templates Window Help

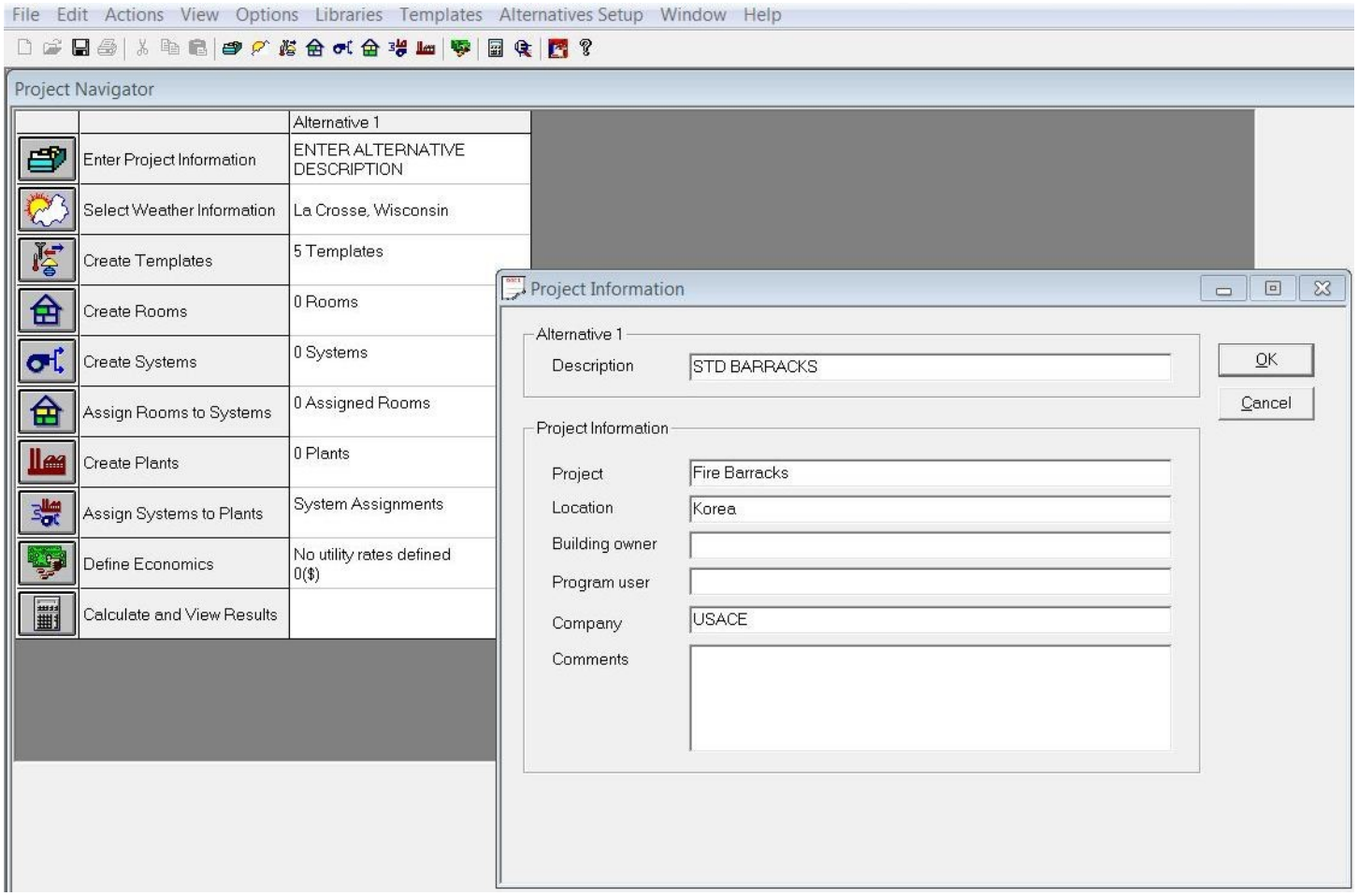
TRANE

Component Tree View - Alternative 1

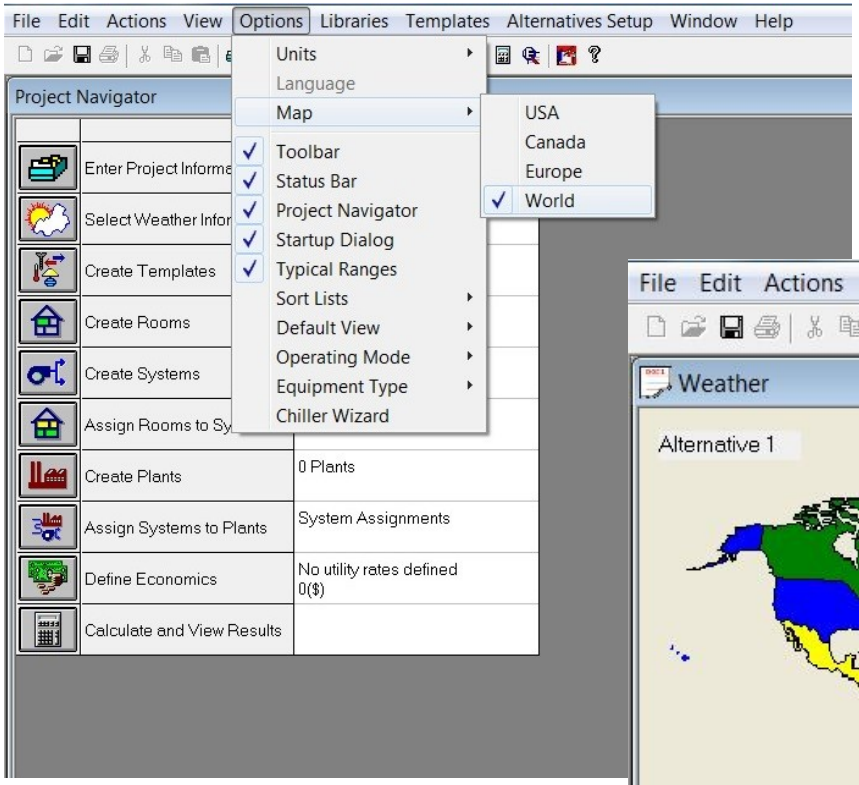
- Project Information
- Economics
- Alternative 1
  - Utility Rates & Life Cycle Costs
    - Recurring/Additional Depreci
    - Utility Rates
  - Energy Mgmt.
  - Cooling plants
    - Plants
      - Cooling equipment
        - Controls
  - Heating plants
    - Plants
      - Heating equipment
  - Base utilities
  - Miscellaneous accessories
  - Systems
    - Options
    - Dedicated OA
    - Temperature / Humidity
    - Fans
    - Coils
    - Fan Overrides
    - Advanced Options
  - Zones
  - Rooms
    - Airflows
    - People & Lighting
    - Floors
    - Miscellaneous Loads
    - Partitions
    - Roofs
    - Walls
    - Openings

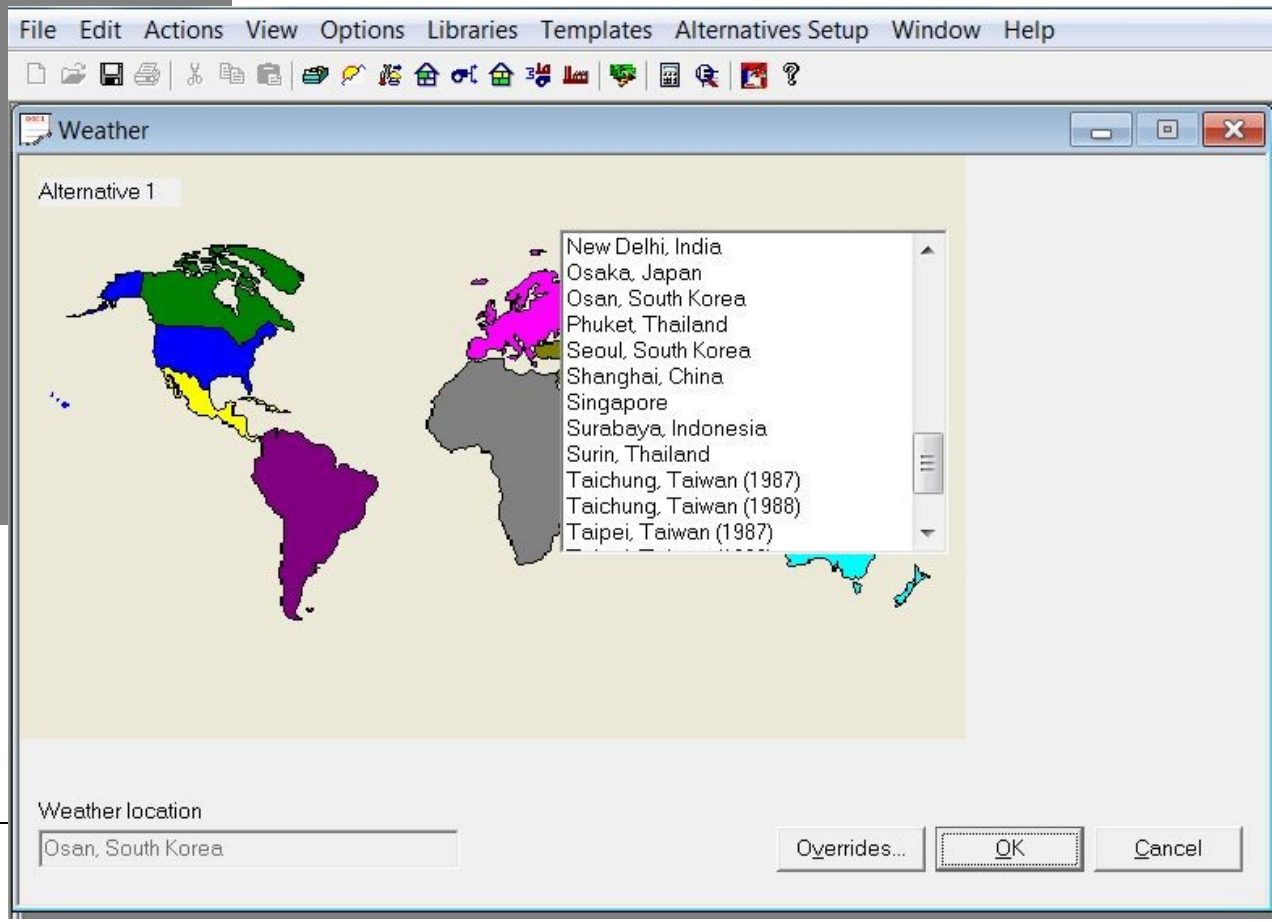
	DOAS-1	DOAS-2	FC-1	FC-10	FC-11	FC-12
System Description	DOAS-1	DOAS-2	FC-1	FC-10	FC-11	FC-12
System Category	Constant Volume - Non-mixing	Constant Volume - Non-mixing	Constant Volume - Non-mixing	Constant Volume - Non-mixing	Constant Volume - Non-mixing	Constant Vo
System Type	Fan Coil	Fan Coil	Fan Coil	Fan Coil	Fan Coil	Fan Coil
Supply Fan Motor Location	Supply	Supply	Supply	Supply	Supply	Supply
Return Fan Motor Location	Return	Return	Return	Return	Return	Return
Fan Configuration	Blow Thru	Draw Thru	Blow Thru	Blow Thru	Blow Thru	Blow Thru
Fan Sizing Method	Peak	Peak	Peak	Peak	Peak	Peak
Block Cooling Airflow						
Block Cooling Airflow Units	cfm	cfm	cfm	cfm	cfm	cfm
Supply Duct Location	Return Air	Return Air	Return Air	Return Air	Return Air	Return Air
Return Air Path	Plenum	Plenum	Plenum	Plenum	Plenum	Plenum
Main Heating Coil Assigned To:	Heating plant - 002	Heating plant - 002	Heating plant - 002	Heating plant - 002	Heating plant - 002	Heating pla
Auxiliary Heating Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Reheat Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Preheat Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Opt Vent Heating Coil Assigned To:	Heating plant - 002	Heating plant - 002	Not available	Not available	Not available	Not availab
Humidification Heating Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Misc. Heating Load Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Main Cooling Coil Assigned To:	Cooling plant - 001	Cooling plant - 001	Cooling plant - 001	Cooling plant - 001	Cooling plant - 001	Cooling pla
Auxiliary Cooling Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Opt Vent Cooling Coil Assigned To:	Cooling plant - 001	Cooling plant - 001	Not available	Not available	Not available	Not availab
Direct Evap. Cooling Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Indirect Evap. Cooling Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Misc. Cooling Load Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Stg 1 Liq. Desiccant Conditioner Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Stg 2 Liq. Desiccant Conditioner Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Stg 1 Desiccant Regenerator Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Stg 2 Desiccant Regenerator Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab
Stg 1 Frost Prev Preheat Coil Assigned To:	Heating plant - 002	Heating plant - 002	Not available	Not available	Not available	Not availab
Stg 2 Frost Prev Preheat Coil Assigned To:	Not available	Not available	Not available	Not available	Not available	Not availab

Entering Project Information

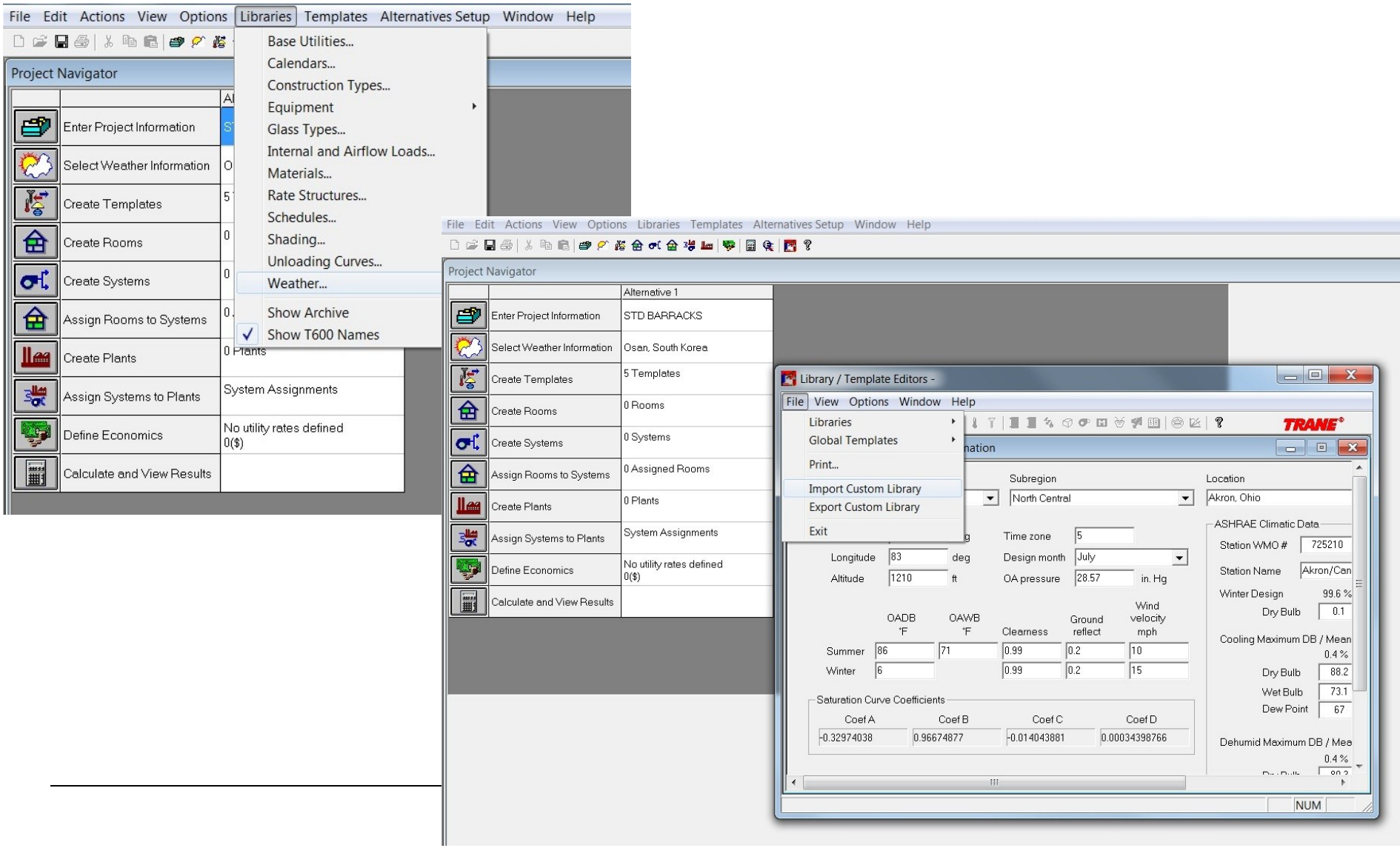


Selecting Weather Map

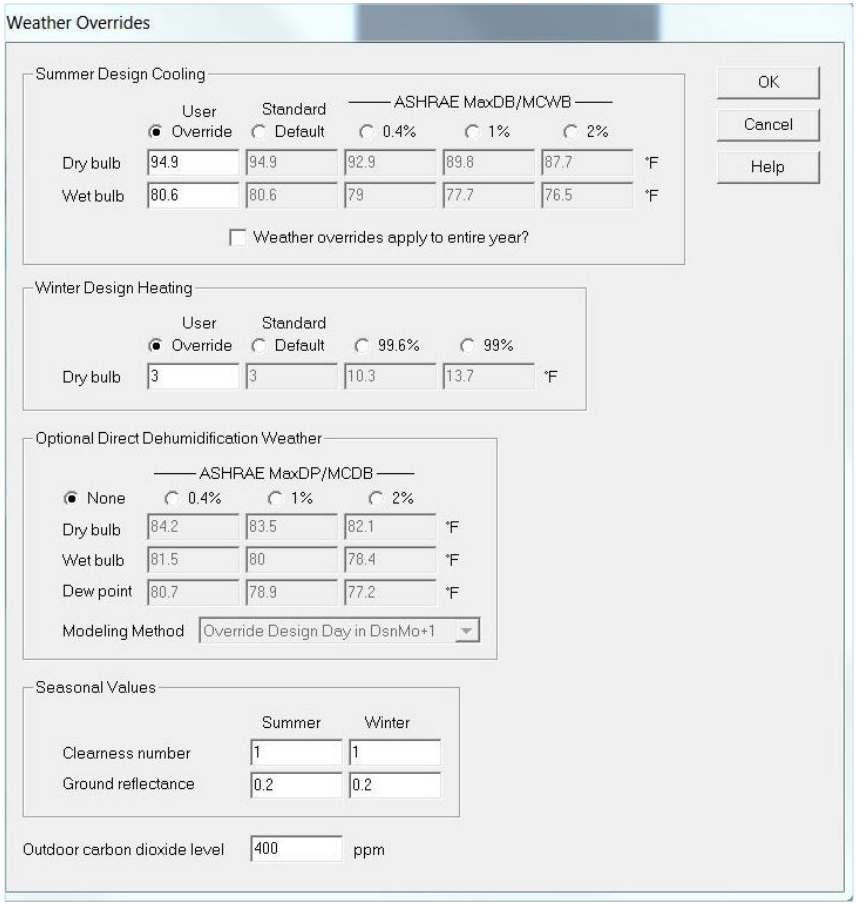


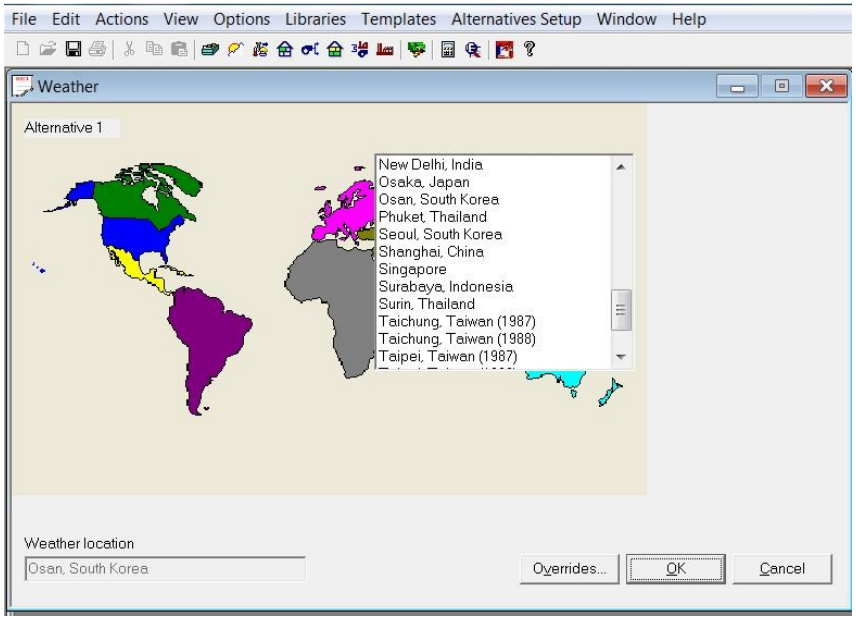


Importing Weather Data

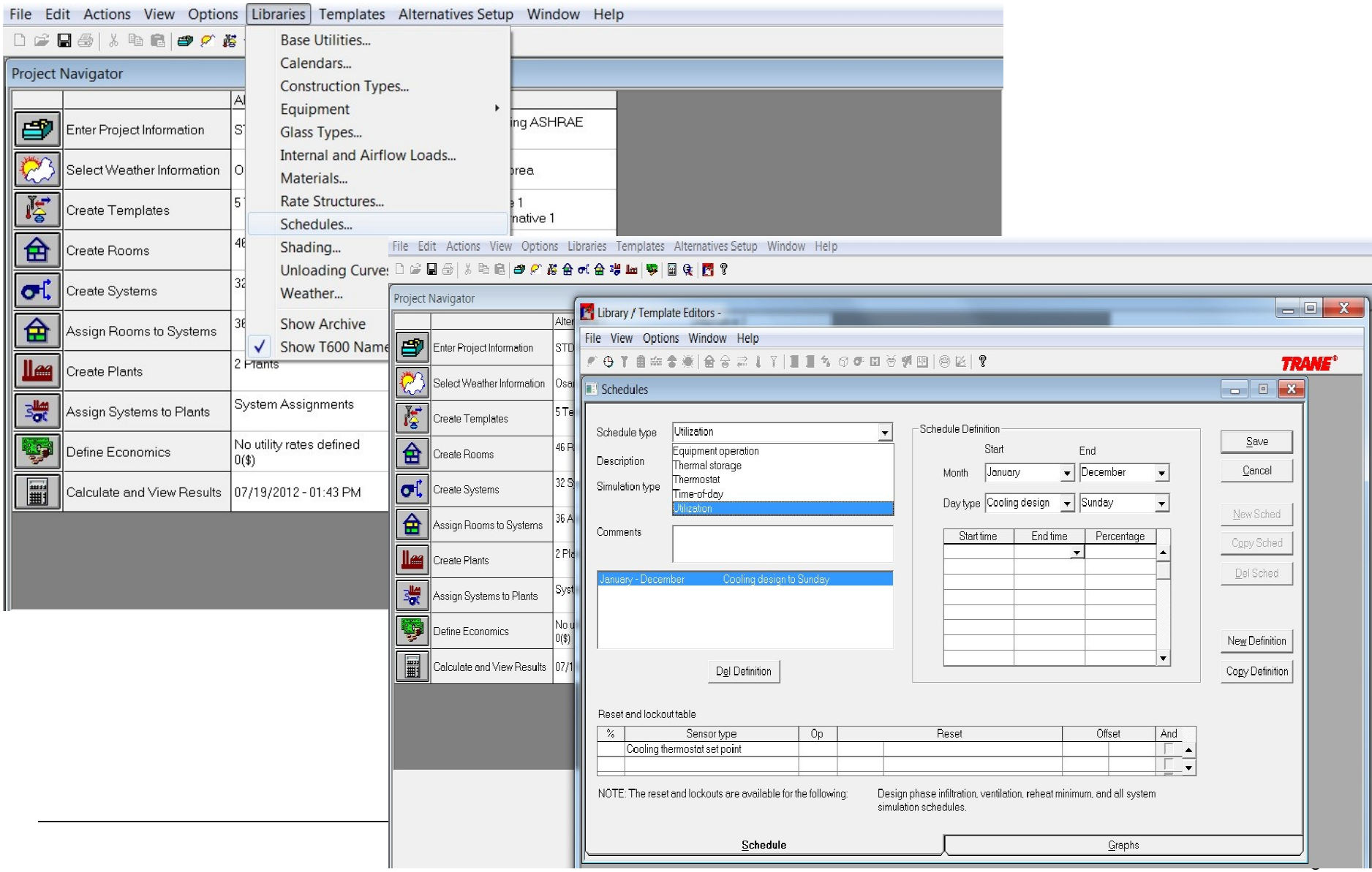


Weather Overrides

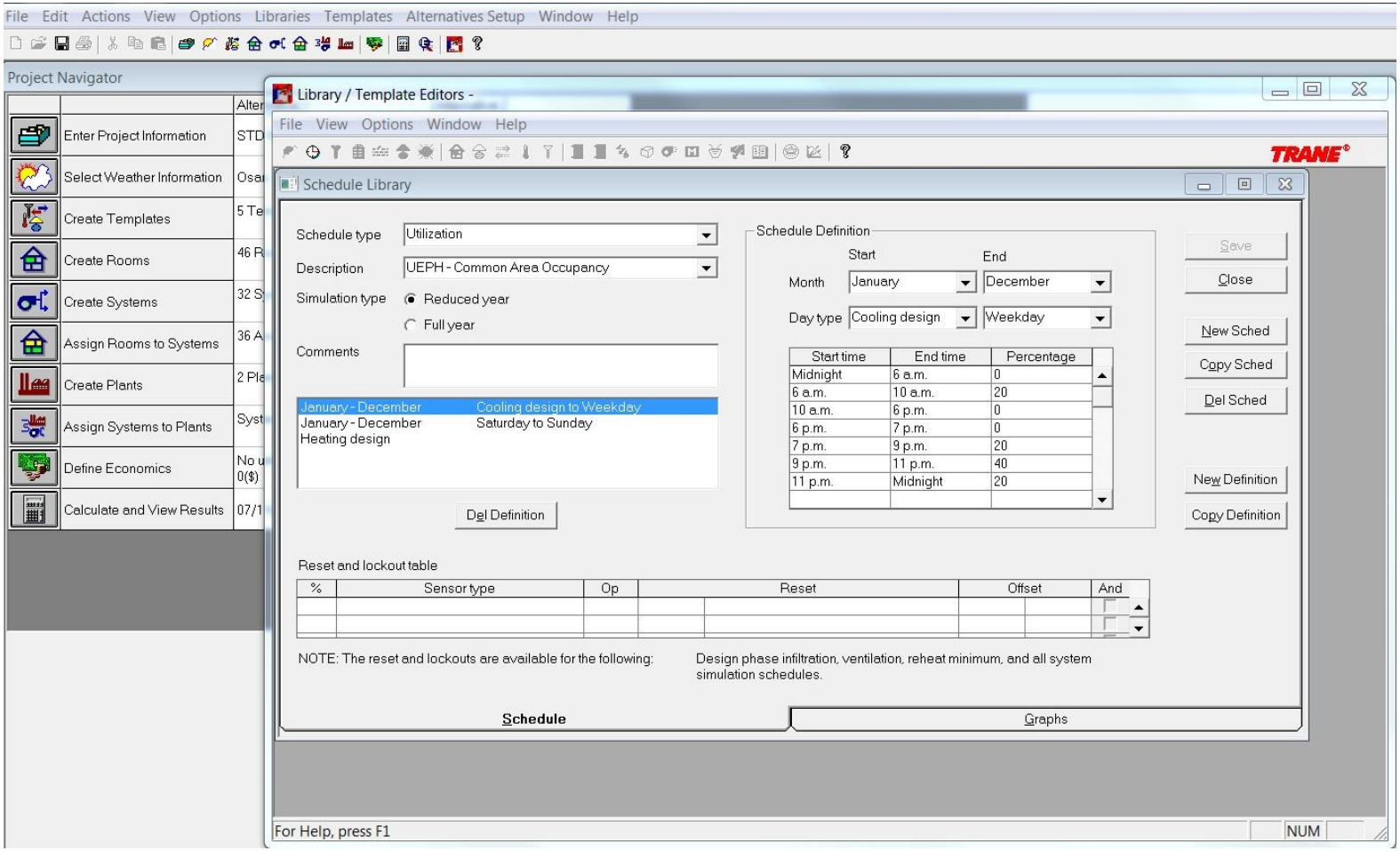




Schedule Library



Utilization Schedule



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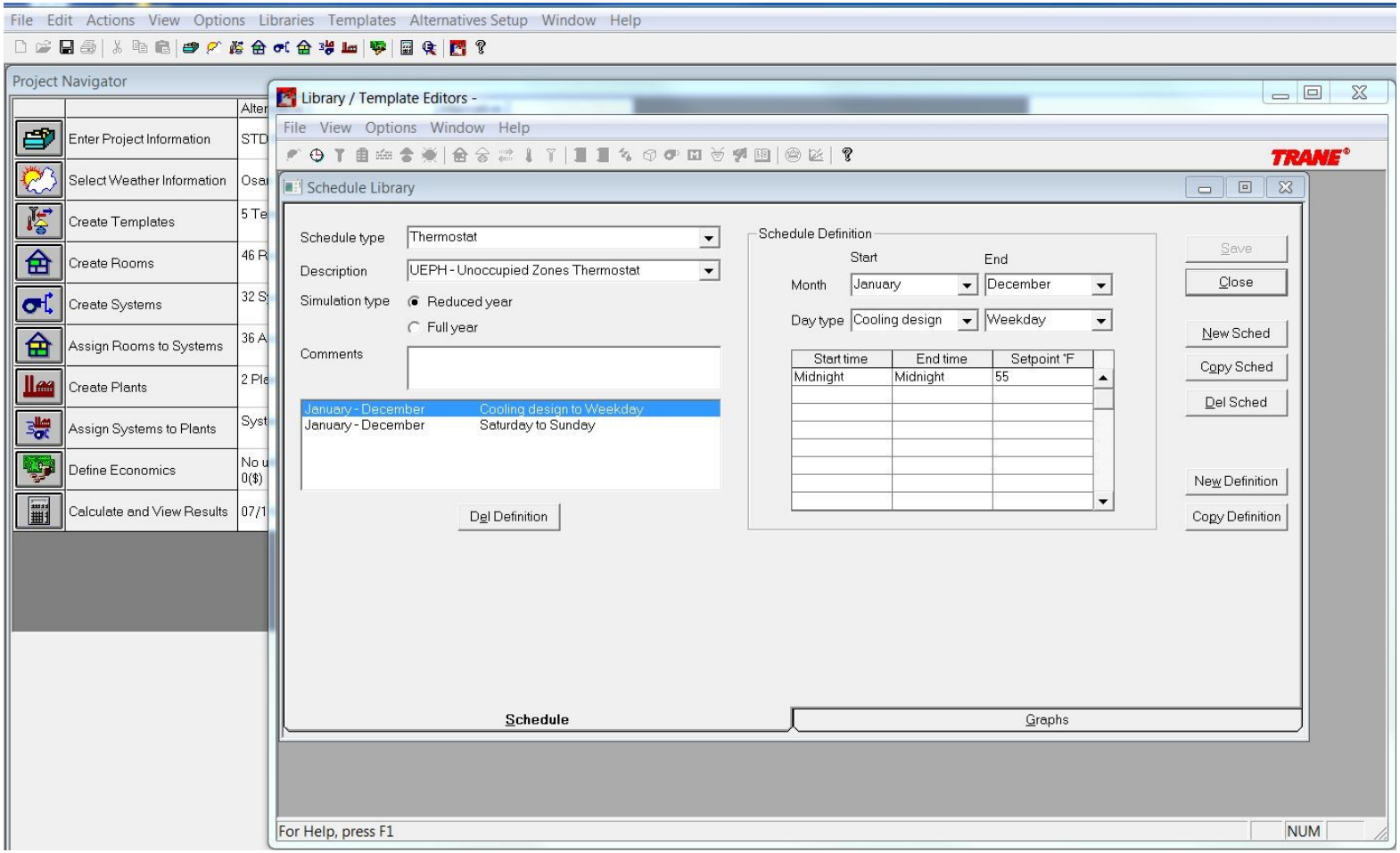
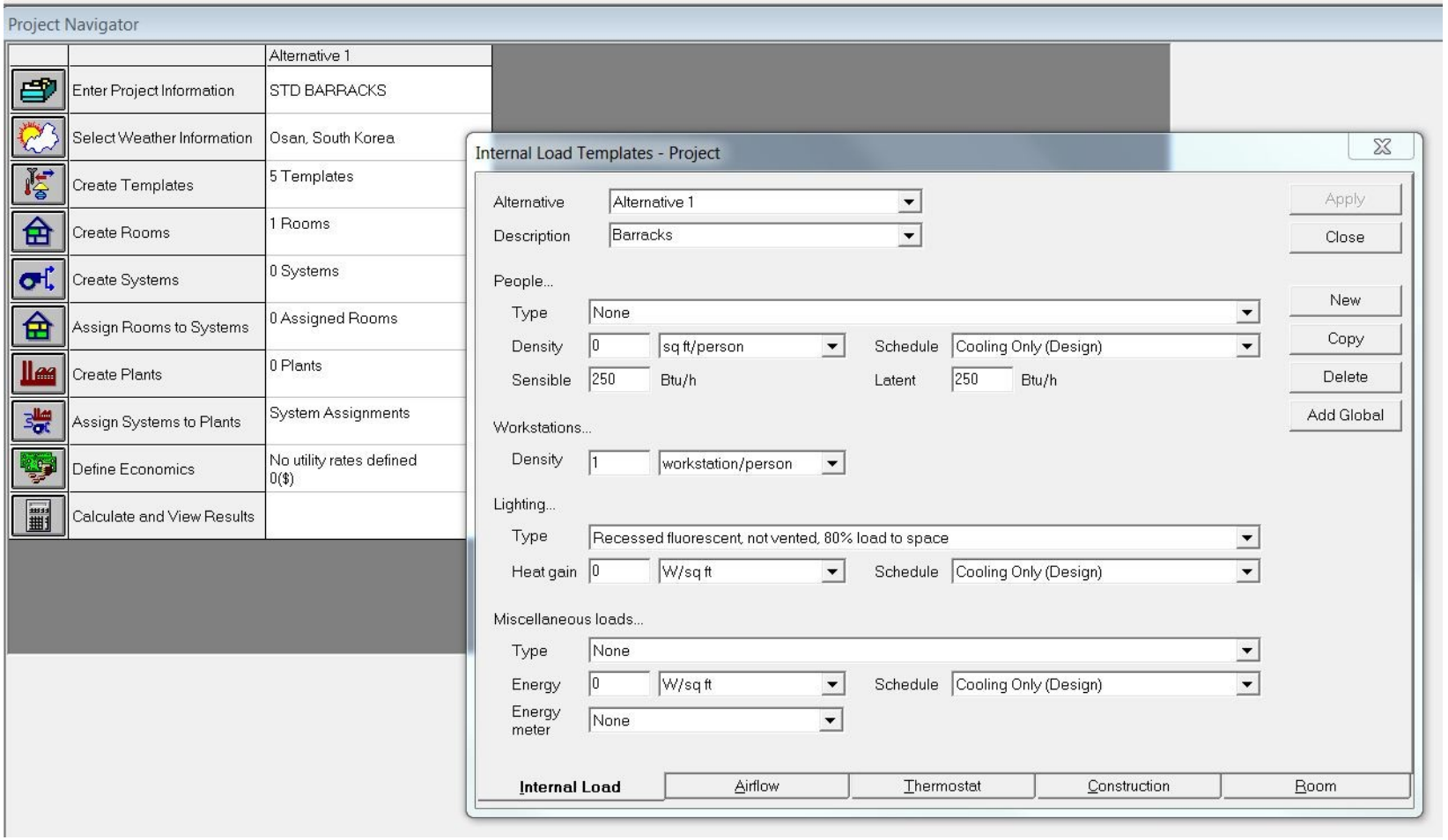
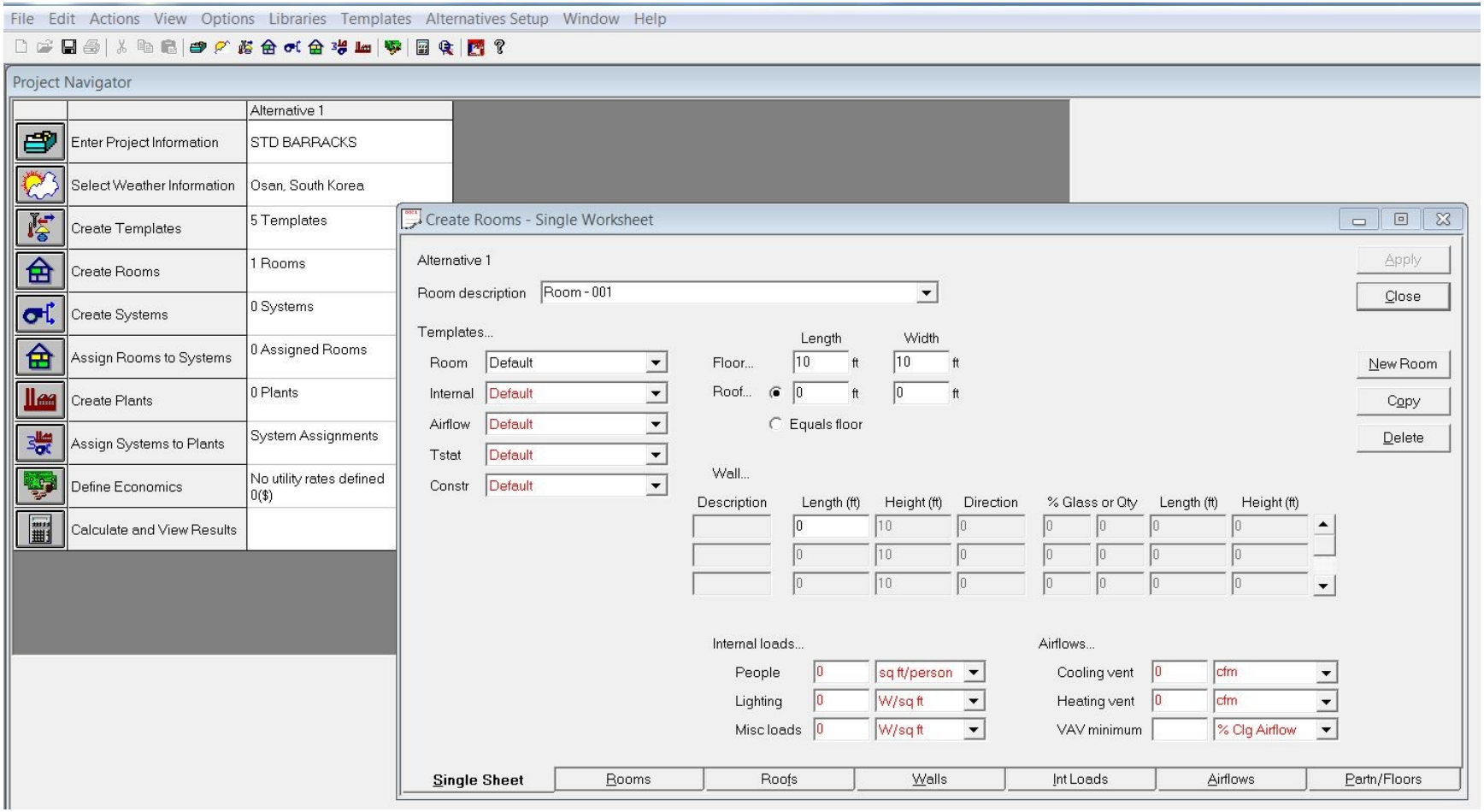
Thermostat Schedule



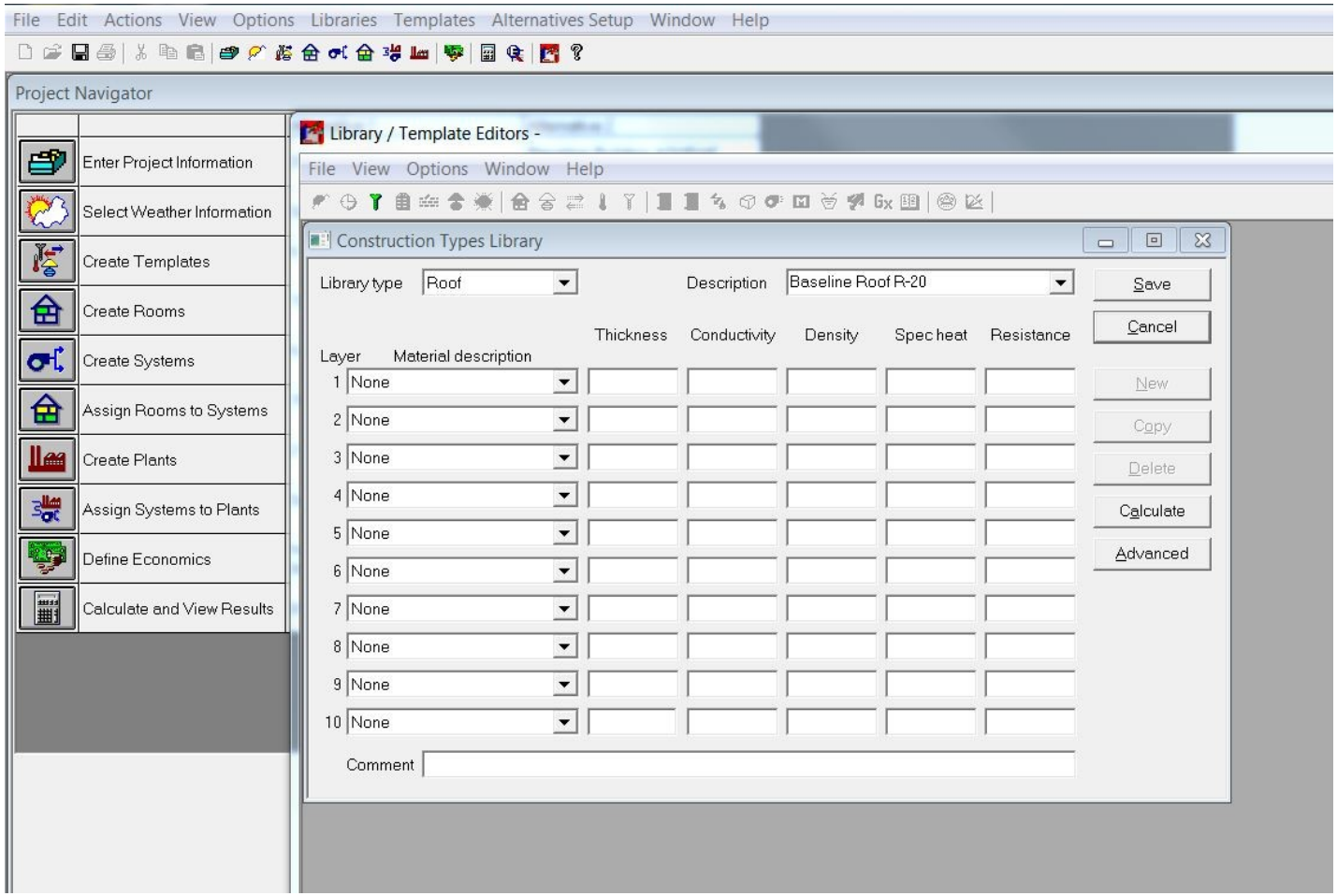
Templates


Project Navigator
Alternative 1
Enter Project Information
STD BARRACKS
Select Weather Information
Osan, South Korea
Create Templates
5 Templates
Create Rooms
1 Rooms
Create Systems
0 Systems
Assign Rooms to Systems
0 Assigned Rooms
Create Plants
0 Plants
Assign Systems to Plants
System Assignments
Define Economics
No utility rates defined
0($)
Calculate and View Results
Internal Load Templates - Project
Alternative
Alternative 1
Description
Barracks
Apply
Close
New
Copy
Delete
Add Global
People...
Type
None
Density
0
sq ft/person
Schedule
Cooling Only (Design)
Sensible
250
Btu/h
Latent
250
Btu/h
Workstations...
Density
1
workstation/person
Lighting...
Type
Recessed fluorescent, not vented, 80% load to space
Heat gain
0
W/sq ft
Schedule
Cooling Only (Design)
Miscellaneous loads...
Type
None
Energy
0
W/sq ft
Schedule
Cooling Only (Design)
Energy meter
None
Internal Load
Airflow
Thermostat
Construction
Room

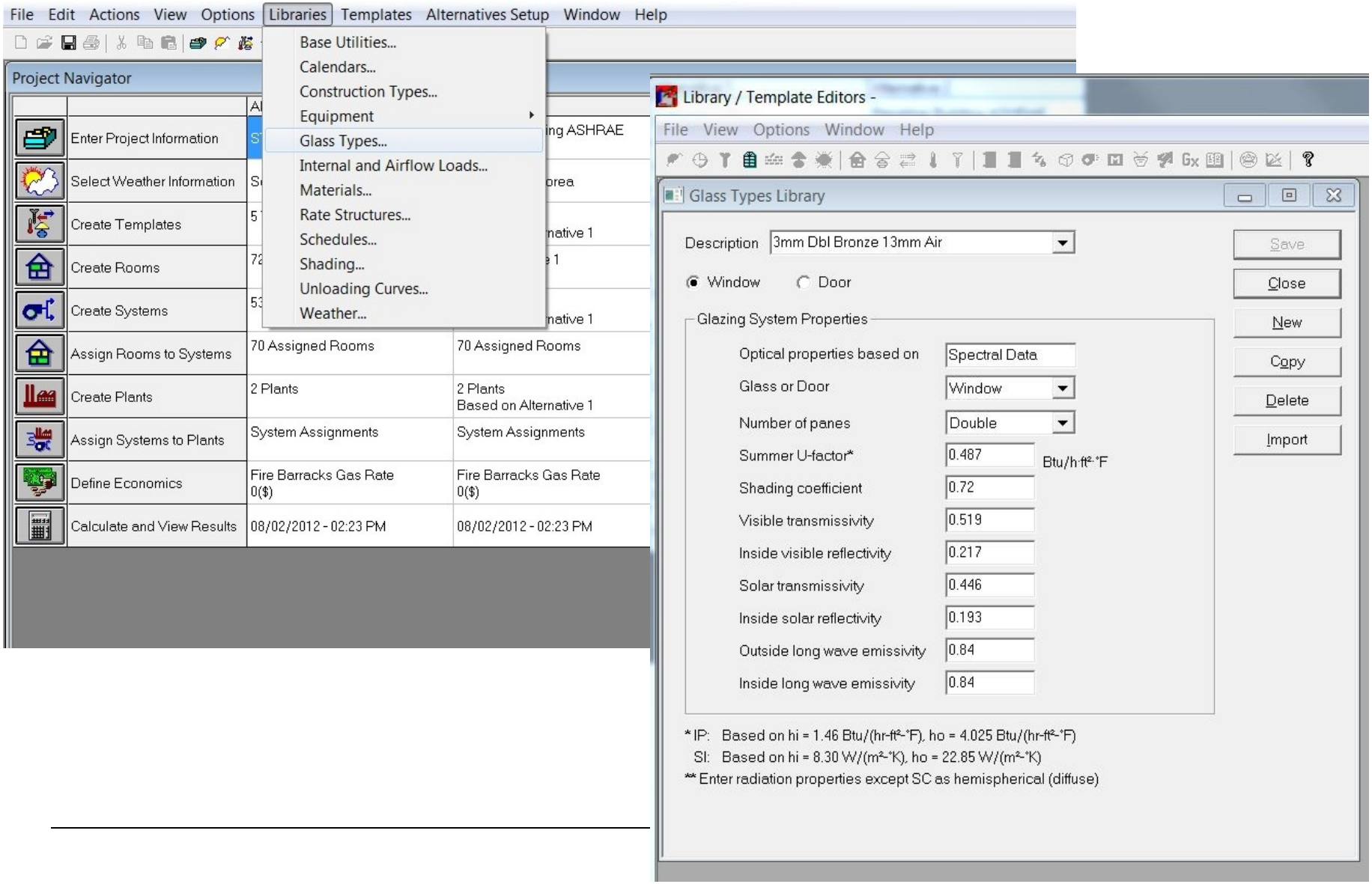
Entering Space Data



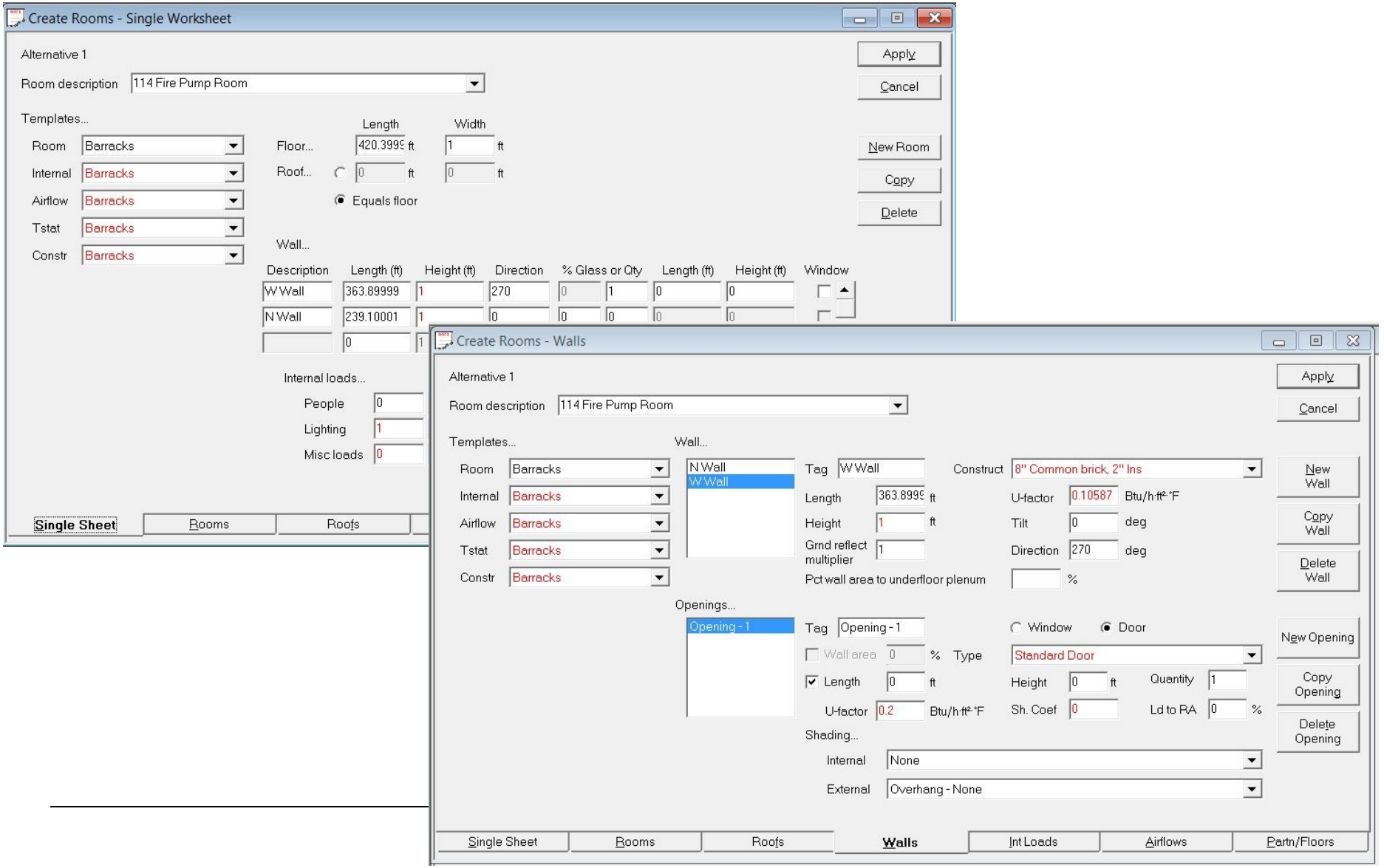
Define A New Roof



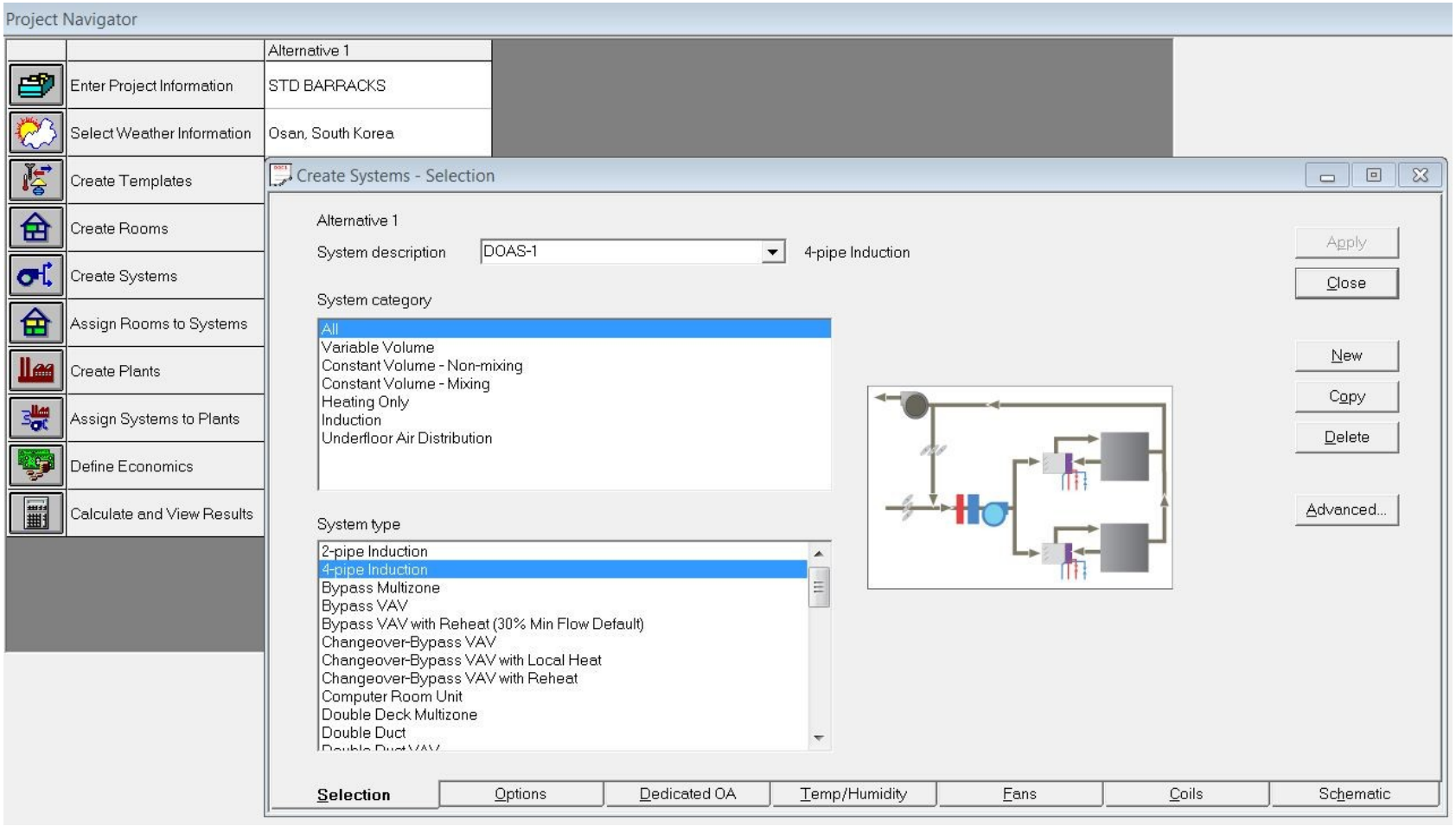
Define Windows and Doors



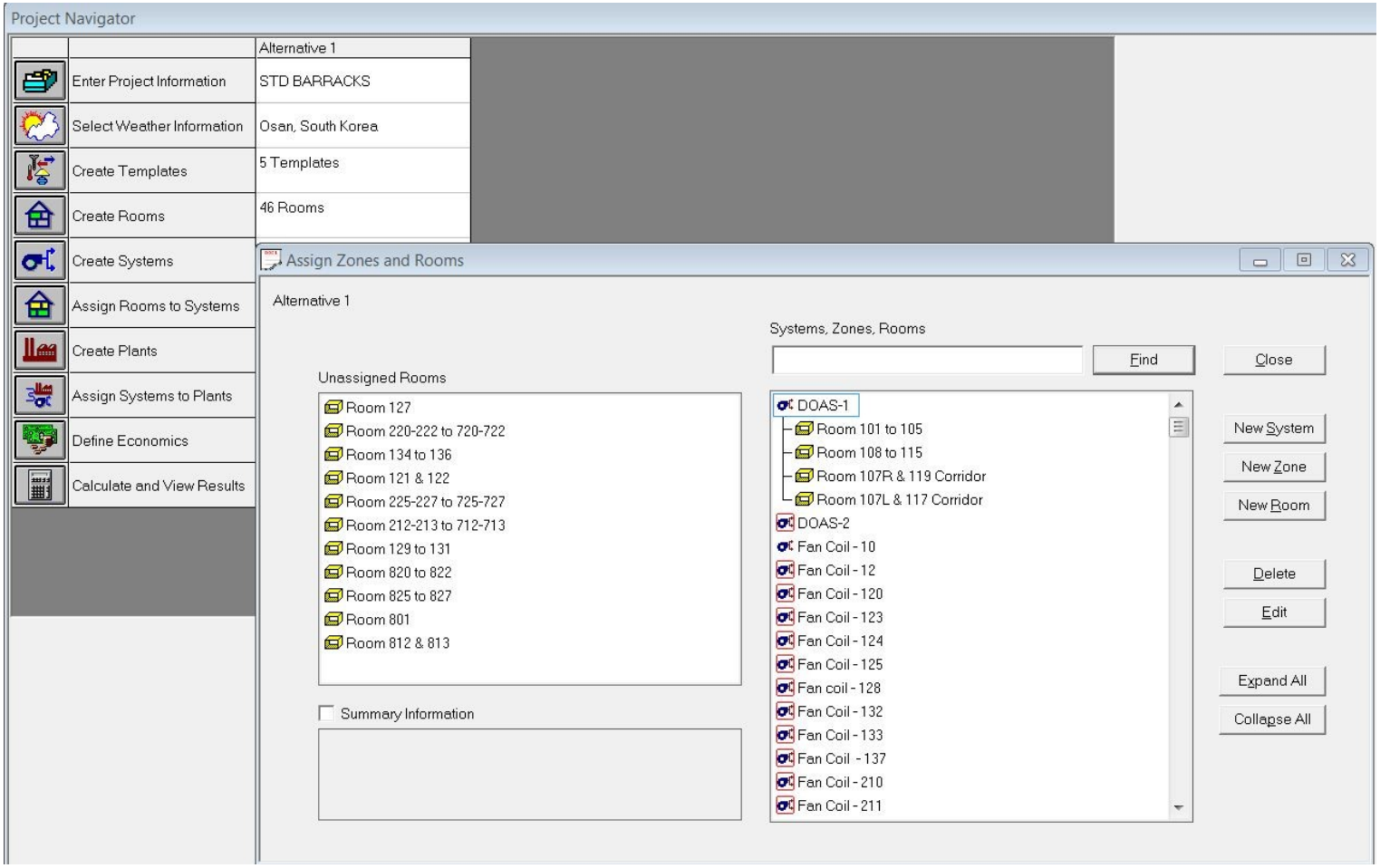
Model a Door


Create Rooms - Single Worksheet
Alternative 1
Room description
114 Fire Pump Room
Apply
Cancel
Templates...
Room
Barracks
Internal
Barracks
Airflow
Barracks
Tstat
Barracks
Constr
Barracks
Length
Width
Floor...
420.3999 ft
1 ft
Roof...
0 ft
0 ft
Equals floor
New Room
Copy
Delete
Wall...
Description
Length (ft)
Height (ft)
Direction
% Glass or Qty
Length (ft)
Height (ft)
Window
W Wall
363.89999
1
270
0
1
0
0
N Wall
239.10001
1
0
0
0
0
0
0
1
Internal loads...
People
0
Lighting
1
Misc loads
0
Single Sheet
Rooms
Roofs
Create Rooms - Walls
Alternative 1
Room description
114 Fire Pump Room
Apply
Cancel
Templates...
Room
Barracks
Internal
Barracks
Airflow
Barracks
Tstat
Barracks
Constr
Barracks
Wall...
N Wall
W Wall
Tag
W Wall
Construct
8" Common brick, 2" Ins
Length
363.8999 ft
U-factor
0.10587 Btu/h·ft²·°F
Height
1 ft
Tilt
0 deg
Grnd reflect multiplier
1
Direction
270 deg
Pct wall area to underfloor plenum
%
New Wall
Copy Wall
Delete Wall
Openings...
Opening - 1
Tag
Opening - 1
Window
Door
Wall area
0 %
Type
Standard Door
Length
0 ft
Height
0 ft
Quantity
1
U-factor
0.2 Btu/h·ft²·°F
Sh. Coef
0
Ld to RA
0 %
New Opening
Copy Opening
Delete Opening
Shading...
Internal
None
External
Overhang - None
Single Sheet
Rooms
Roofs
Walls
Int Loads
Airflows
Partn/Floors

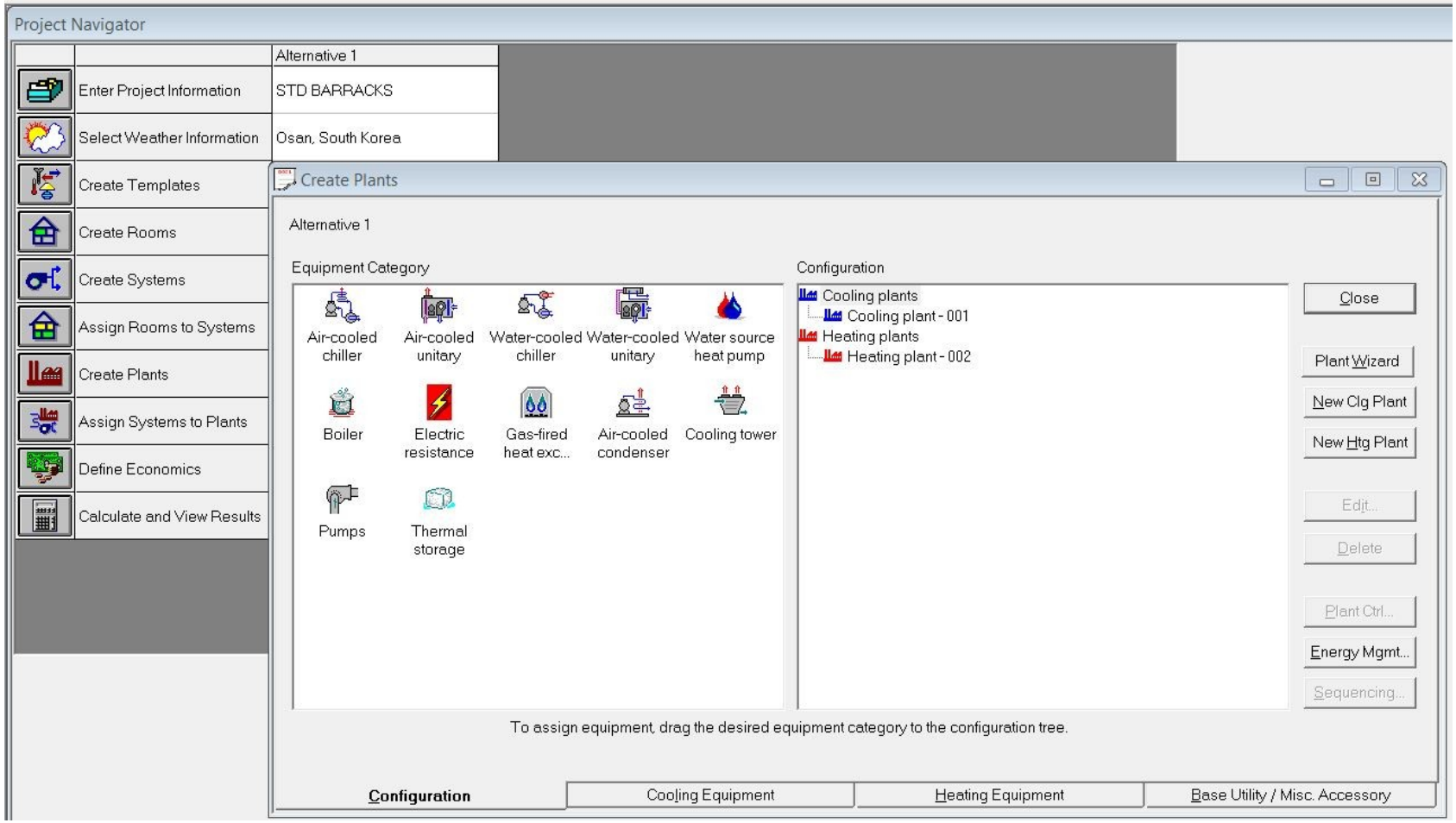
Creating Systems



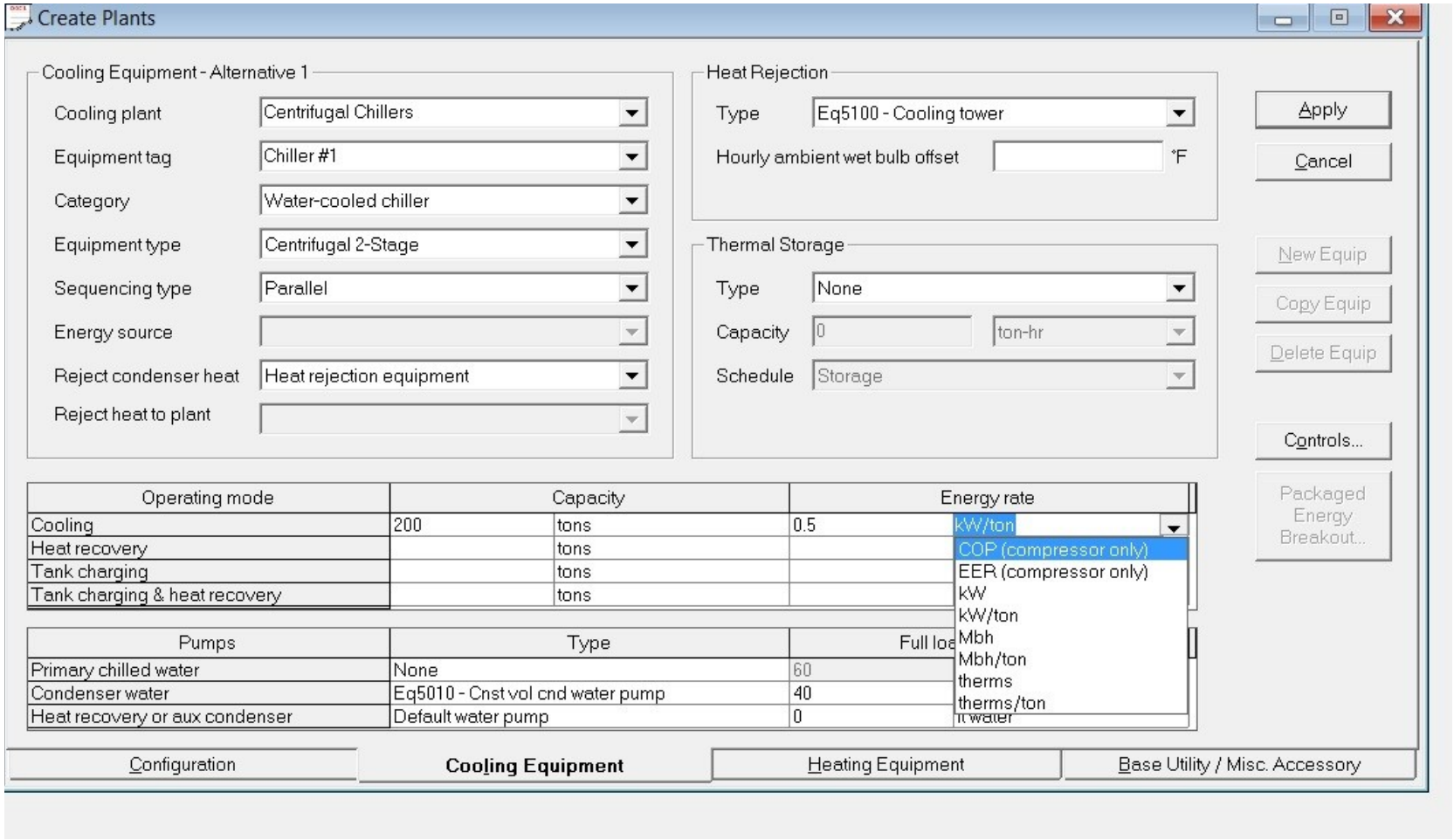
Assign Rooms to Systems



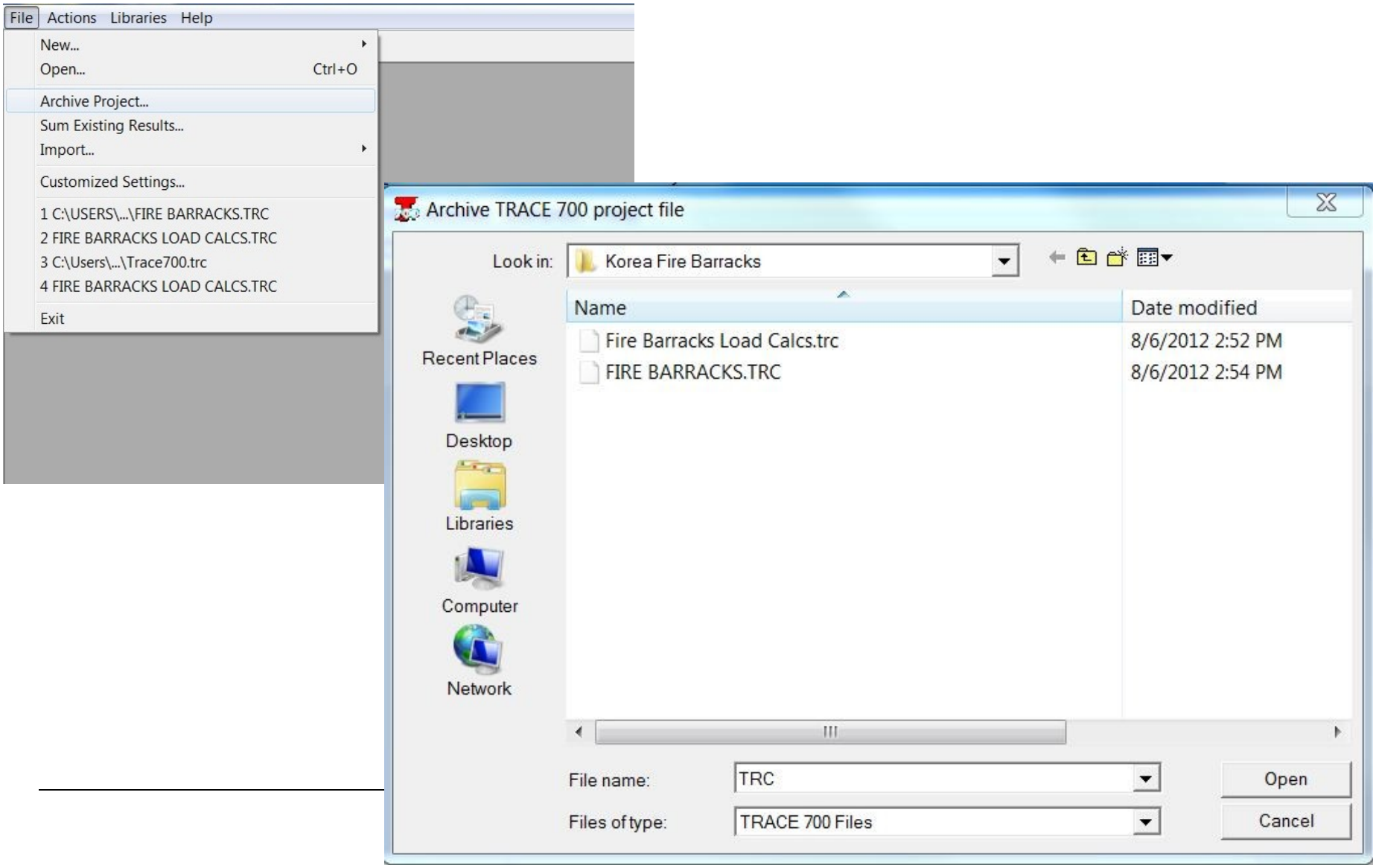
Creating Plants



Cooling Equipment



Archive a Project



Welcome to TRACE 700!

Technical Support

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For advanced assistance with this software or with modeling and analyzing HVAC loads, contact the C.D.S.™ Support Center.

To reach us:

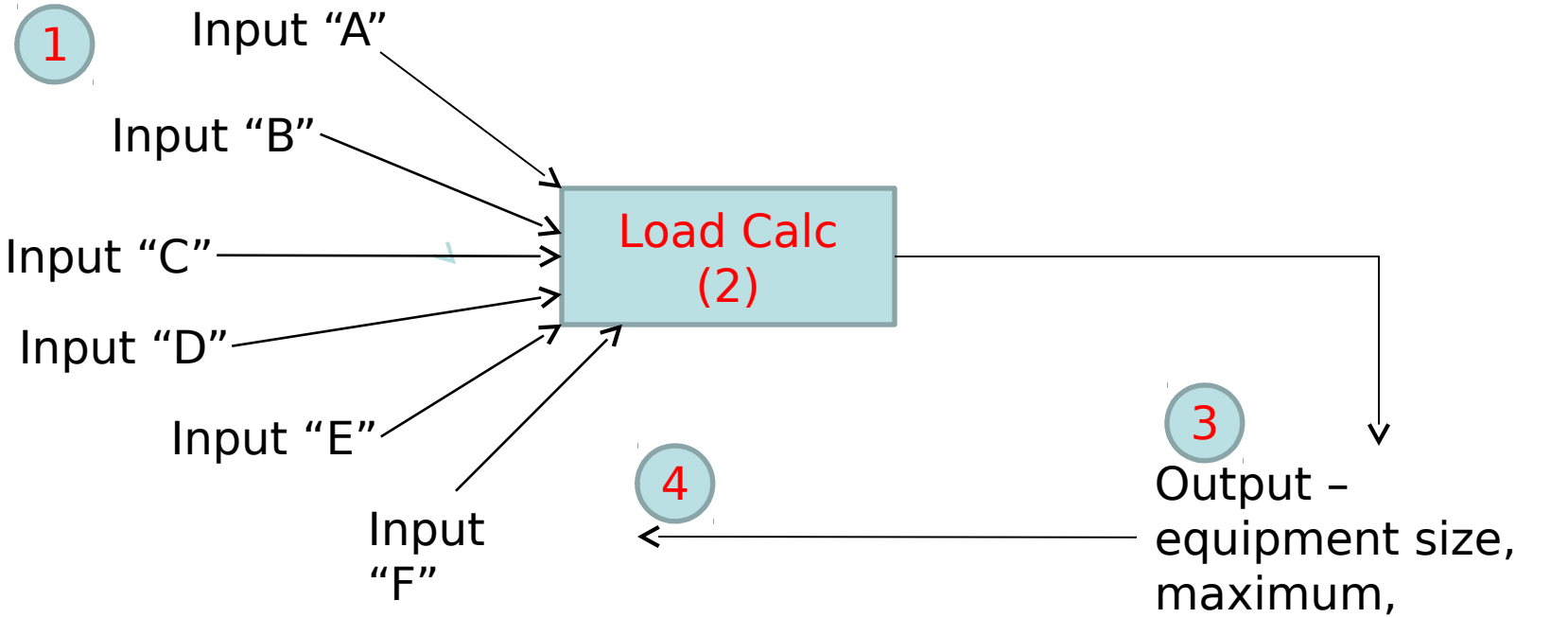
phone:	608-787-3926	**Hours**
fax:	608-787-3005	Monday-Thursday
e-mail:	cdshelp@trane.com	8:00 a.m. - 5:30 p.m. (Central)
mail:	Trane	Friday
	Attn: C.D.S. Group	8:00 a.m. - 5:00 p.m. (Central)
	3600 Pammel Creek Road	
	La Crosse, WI 54601-7599	

To learn more about Trane, visit our Web site at www.trane.com. For more information about C.D.S., visit www.tranecds.com.

We are committed to continuous product improvement. Please send comments to cdshelp@trane.com and be sure to include the name and version of the program.

BUILDING STRONG®

Load Calculation Process



Steps:

1. Provide inputs to load calculation
2. HVAC engineer to initially size system
3. Analyze outputs to determine concept/final equipment/system
4. Modify inputs based on system(s) selected and re-run calc
5. Repeat, repeat, repeat until equipment/system is proven – design is an iterative process….

Resources

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FEEDBACK? (e-mail - Lori or me)

QUESTIONS/COMMENTS?

Backup Slides

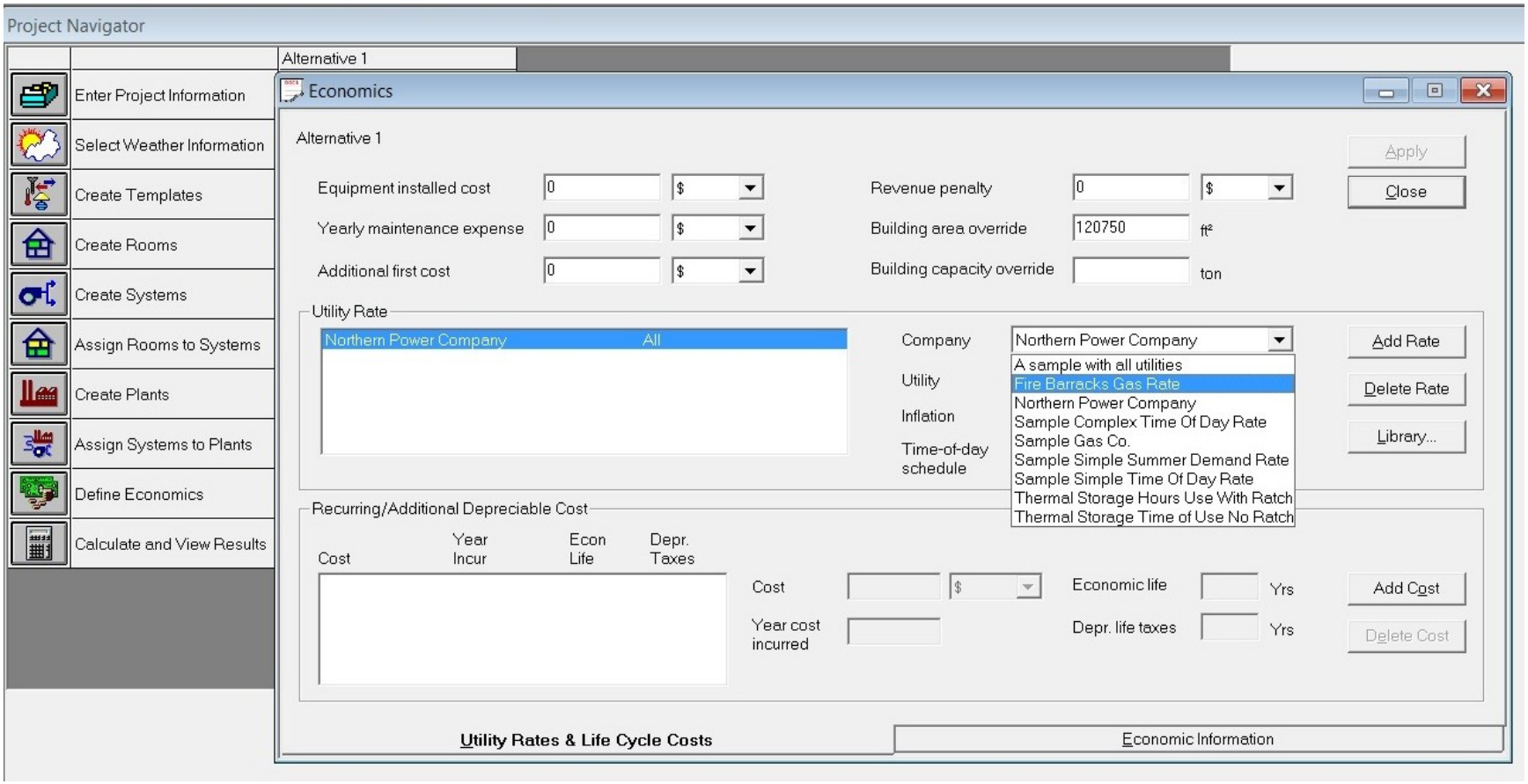
Local Weather Report

“Eh brah, it’s goin’ be cold ‘dis morning with mauka showers…. Afternoon goin’ be hot with makai sun… tradewinds will be gusty so, you ‘no, hang onto your da kine.”

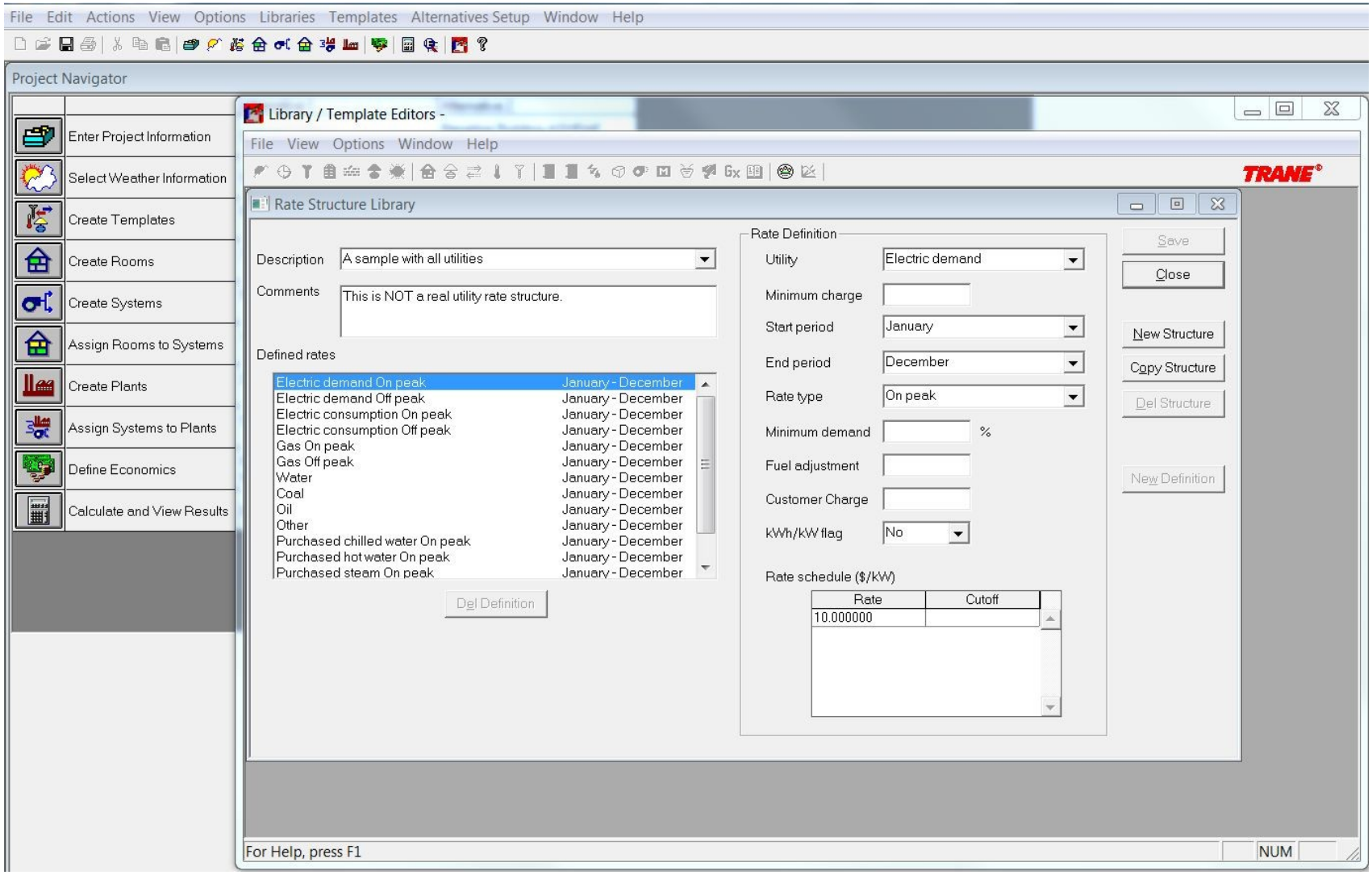
Local Weather Report (translation)

“We will be expecting this morning to be in the mid-60’s (deg. F) with showers in the Ko’olau mountains. This afternoon it will be in the mid 80’s with continued sunshine along Waikiki Beach. Winds will be from the Northeast gusting up to 15 miles per hour.

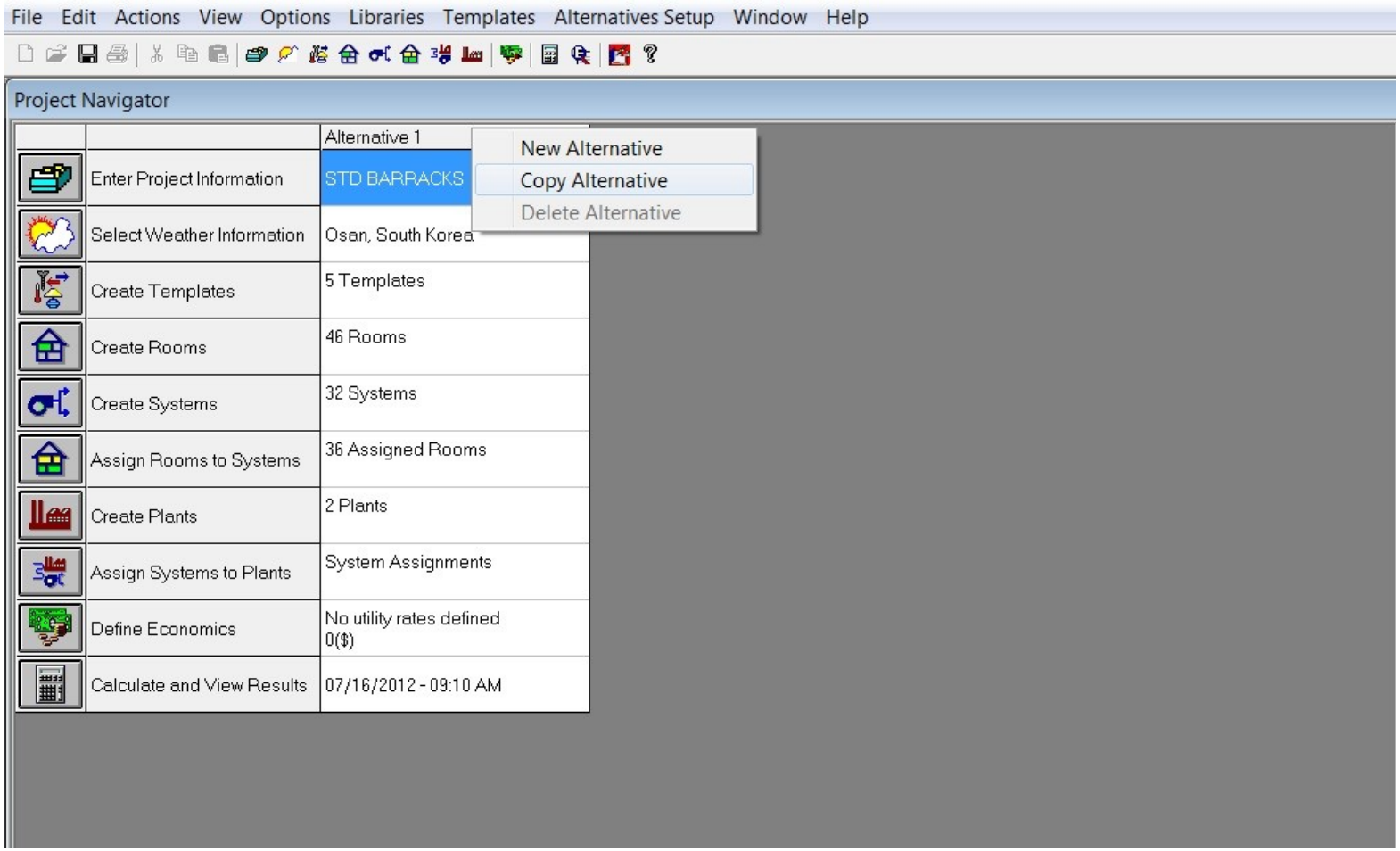
Entering Utility Rates



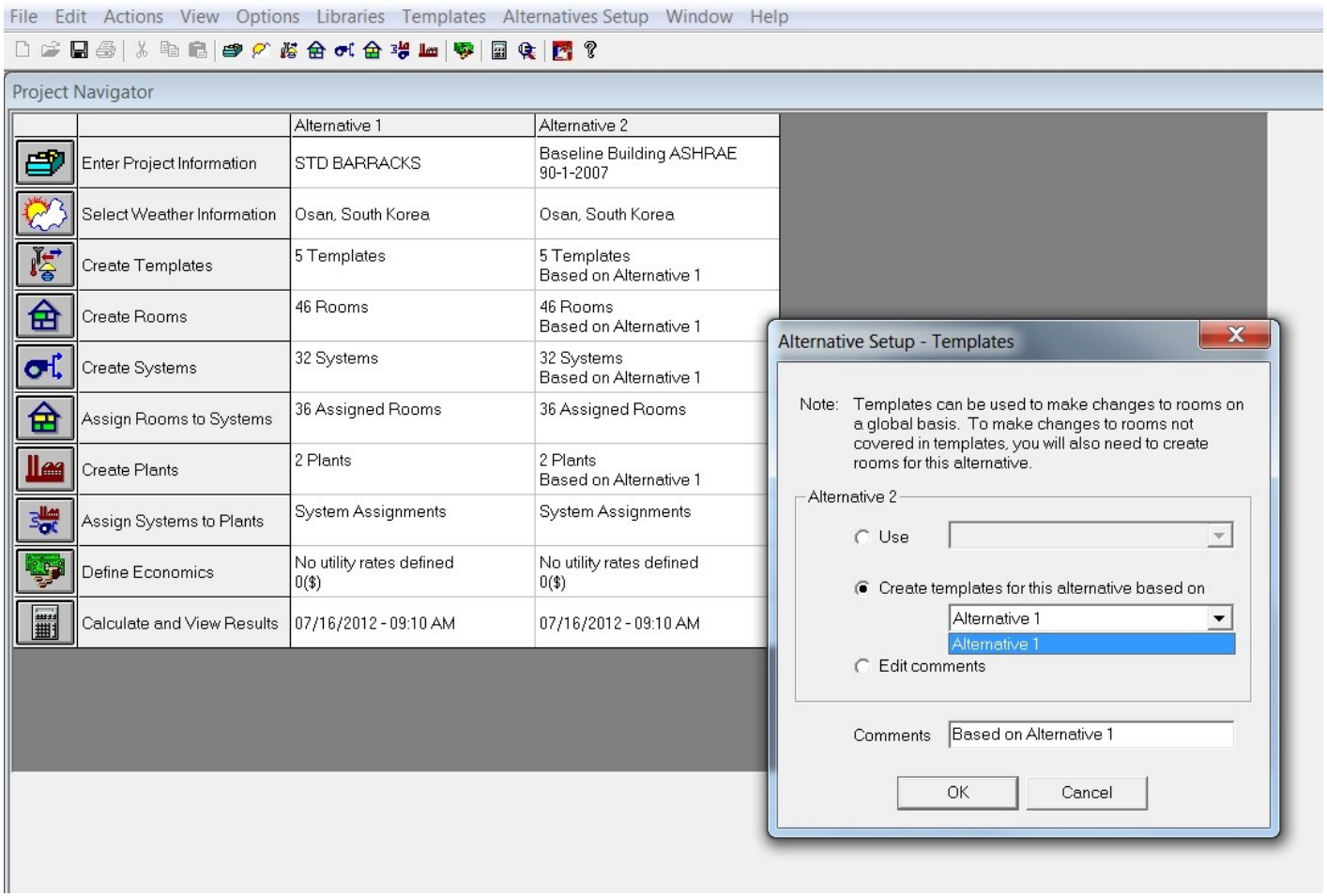
Define New Utility Rate



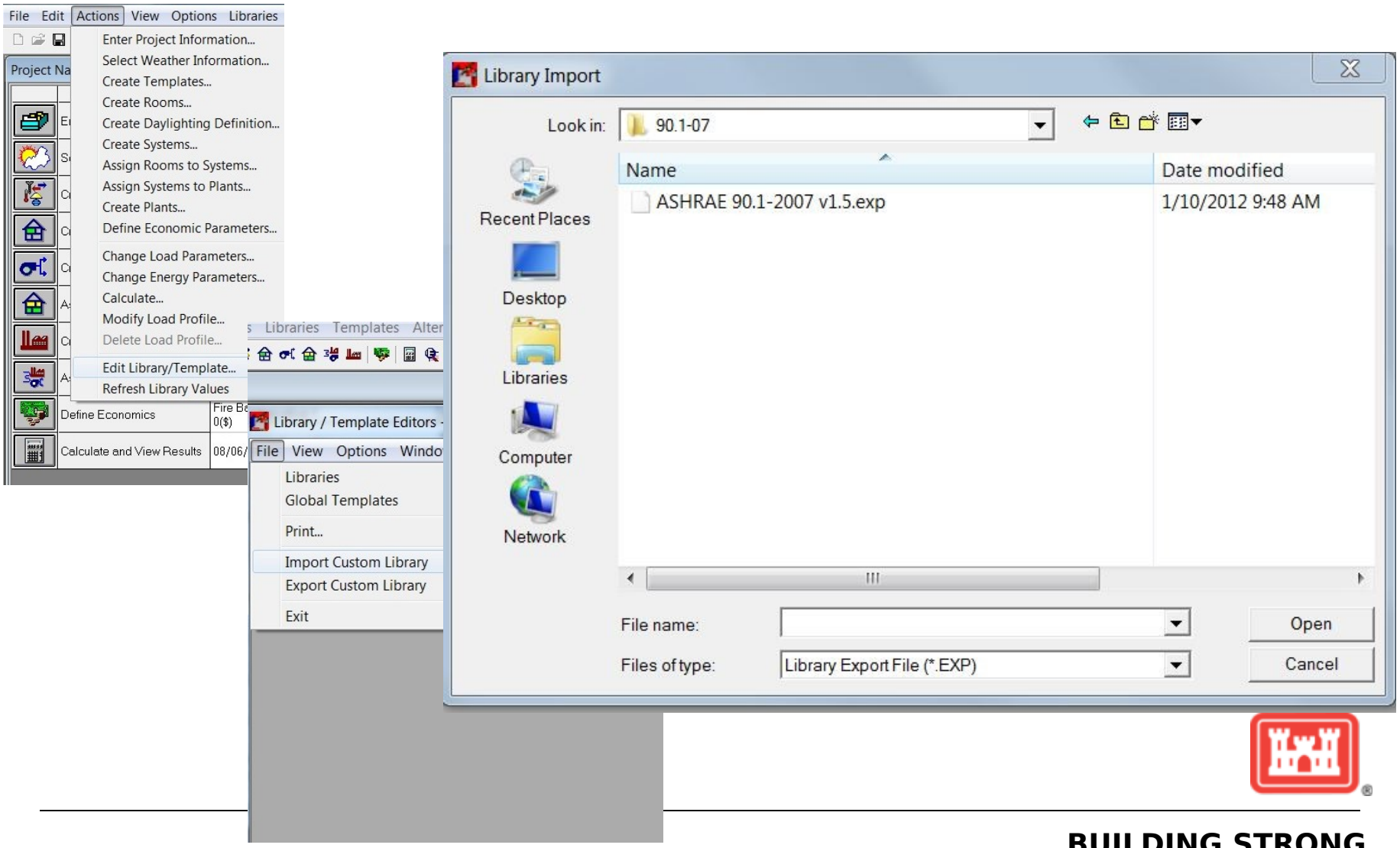
Creating a Baseline Building



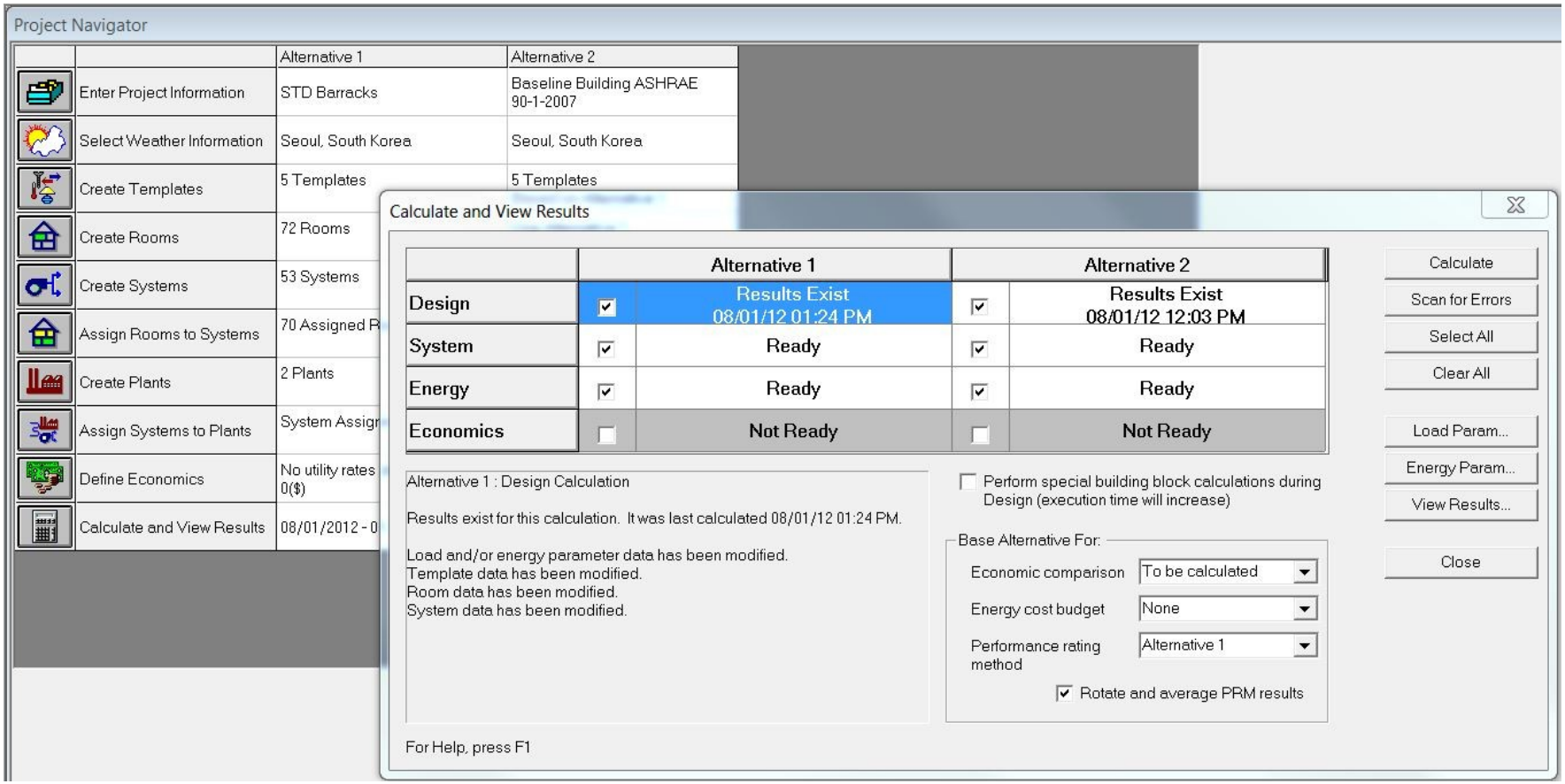
Entering ASHRAE 90.1 Requirements for Baseline Building



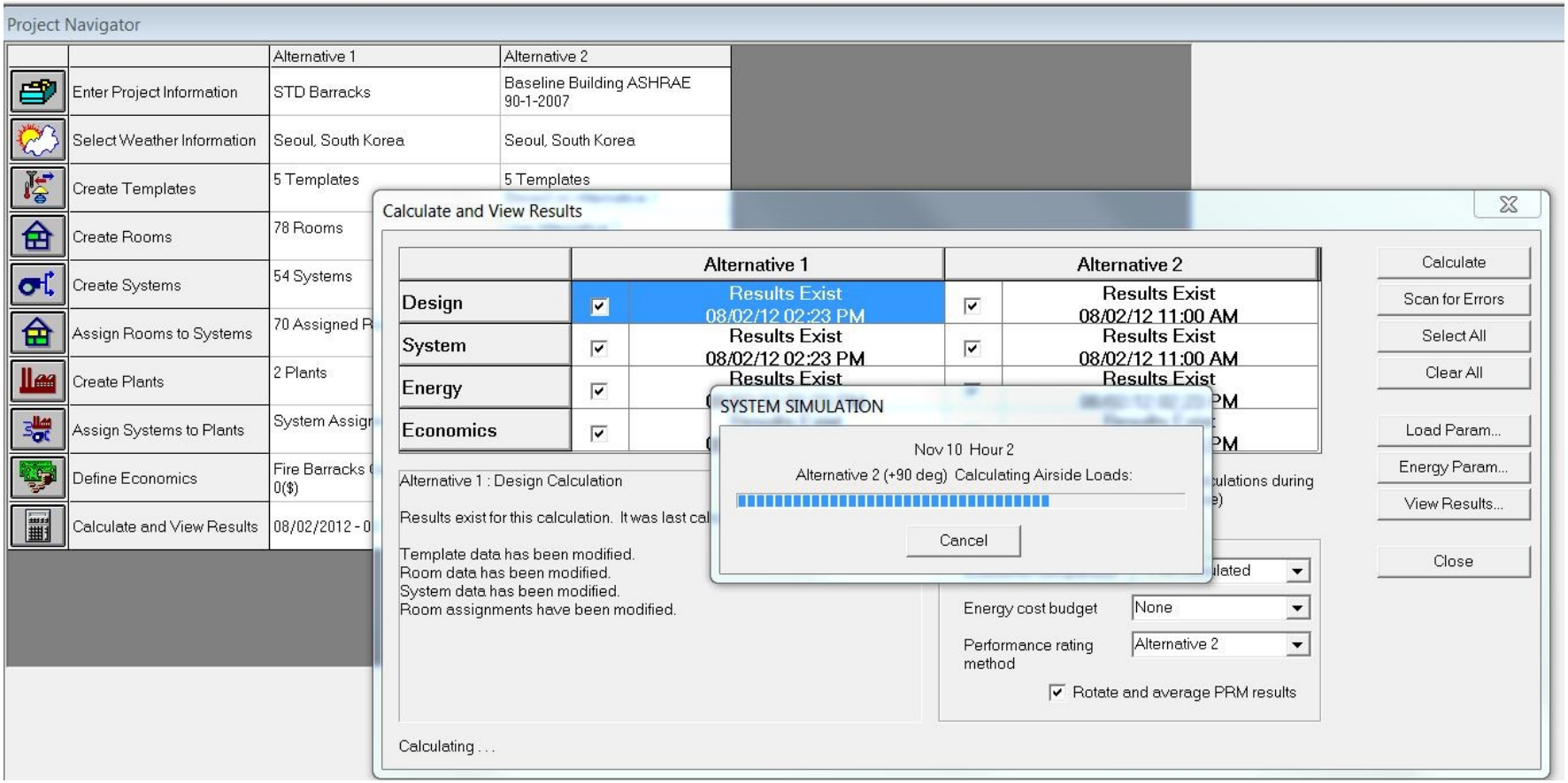
Import ASHRAE 90.1-2007 Library Files



Running Calculations



Running Calculations



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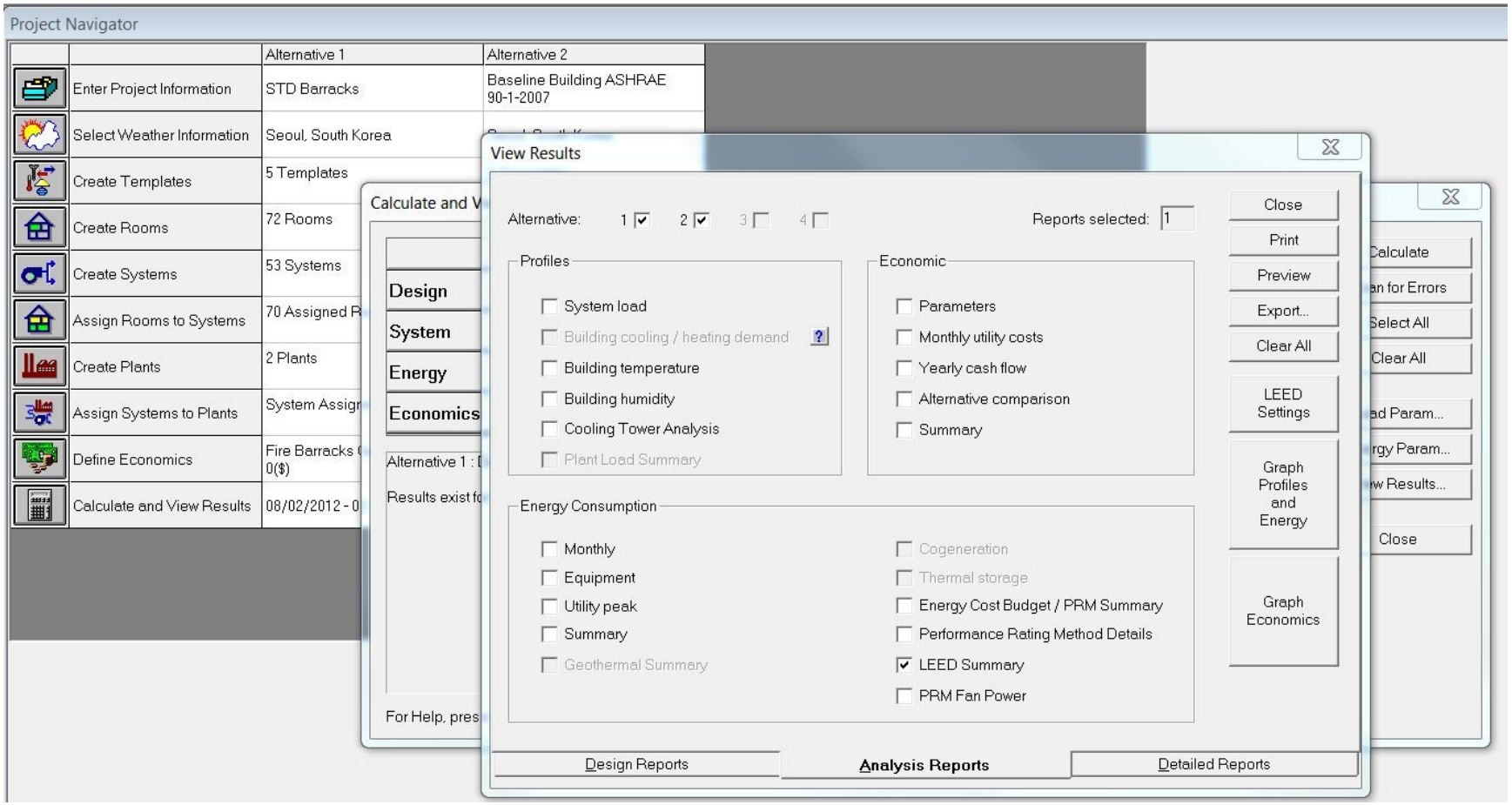
Viewing Reports



View Data Entries